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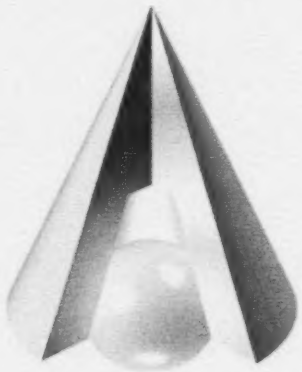
Health and Work in the Family: Evidence from Spouses' Cancer Diagnoses



by Sung-Hee Jeon and R. Vincent Pohl

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^{r} revised
x suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E} use with caution
F too unreliable to be published
* significantly different from reference category ($p < 0.05$)

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Abstract

Using Canadian administrative data from multiple sources, this study provides the first nationally representative estimates of the effect of individuals' cancer diagnoses on the employment and earnings of their spouses and on total family income. This effect is theoretically ambiguous, but clear evidence for a reduction in employment and earnings among men and women is found. These results are interpreted as individuals taking time off work in order to care for their sick spouse (caregiver effect). In order to give a causal interpretation of the results, a combination of matching and individual fixed effects are employed.

Key words: spousal cancer diagnosis, spousal employment, spousal earnings

Executive summary

Changes in health status may affect not just the individuals who experience such changes, but also their family members. For example, if the main earner in a family loses his or her ability to generate income due to a health shock, it invariably affects the financial situation of the spouse and other dependents. In addition, spouses and working-age children may themselves increase or reduce their labour supply to make up for the lost income ("added worker effect") or care for a sick family member ("caregiver effect"). Since consumption smoothing and self-insurance occur at the household level, the financial effects of health for other family members have important policy implications. To shed light on such effects, this study analyzes how one spouse's cancer diagnosis affects the employment and earnings of the other spouse and (before-tax) total family income using administrative data from Canada.

The data used in this paper come from five administrative sources and are combined in the 1991 Census–Longitudinal Worker File (LWF) linkage data. The sources include the Canadian 1991 Census of Population, the Canadian Cancer Database, the Canadian Mortality Database, the LWF, and the T1 Family File. This study combines matching methods with a generalized difference-in-differences (DID) strategy to control for observed and unobserved heterogeneity. Coarsened Exact Matching is first applied to the data to make the treatment group—individuals whose spouses have been diagnosed with cancer—and the control group—individuals whose spouses have never been diagnosed with cancer—observably similar. To make the DID approach more robust, individual fixed effects are included. The study data and methods allow for interpretation of the estimation results in a causal manner, which is essential for an informed policy discussion.

The study finds that both men and women reduce their employment rates by about 2.4 percentage points in the years following their spouse's cancer diagnosis. Since women have lower average employment rates, this decrease represents a larger relative decline for them. Furthermore, annual earnings decrease by about $2,000 for men and $1,500 for women. In relative terms, this decline corresponds to 3.4% for men and 5.9% for women. Finally, the results show substantial decreases in family income caused by the decline in the earnings of individuals diagnosed with cancer and a parallel decline in the earnings of their spouses. For men whose wives have been diagnosed with cancer, family income decreases by up to 4.8% while a corresponding reduction for women amounts to 8.5%.

While the labour market effects of spousal health shocks are theoretically ambiguous, the empirical results of this research clearly reject the added-worker hypothesis in favour of the caregiver hypothesis. Individuals whose spouses are diagnosed with cancer (i.e., a sudden and severe negative change in health) experience a decrease in employment and earnings. A cancer diagnosis also often implies that the affected spouse's life expectancy is suddenly reduced, in which case the other spouse may want to work less temporarily in order to spend time with the sick husband or wife. Therefore, the larger negative employment and earnings effects that were found for both men and women in response to spousal cancer may be due to both caregiving needs and the desire to enjoy more leisure time together after the cancer diagnosis.

Overall, this study's results provide novel and important evidence on the intra-family labour market effects of one family member's severe health shock. The magnitude of these effects is substantial, suggesting that a cancer diagnosis has the potential to change labour supply from a level that is optimal when both spouses are healthy to a scenario that can strongly affect the family's financial well-being—in addition to the ensuing psychological costs of dealing with a health shock.

1 Introduction

Changes in health status may affect not just the individuals who experience such changes but also their family members. For example, if the main earner in a family loses the ability to generate income due to a health shock, the financial situation of the spouse and other dependents is invariably affected. In addition, spouses and working-age children may themselves increase their labour supply to make up for the lost income or reduce it to care for a sick family member. Since consumption smoothing and self-insurance occur at the household level, the financial effects of health shocks for other family members have important policy implications. To shed light on such effects, this study analyzes how one spouse's cancer diagnosis affects the employment and earnings of the other spouse and total family income using administrative data from Canada's national statistical agency, Statistics Canada.

As in other developed countries, cancer is one of the leading causes of mortality and morbidity in Canada. Almost 200,000 individuals were diagnosed with cancer in 2014. According to 2011 data, it is the leading cause of death, accounting for 30% of all deaths.[1] With recent medical advances, however, survival chances following a cancer diagnosis have improved. For instance, the average five-year survival rate for all cancers in Canada increased from 56% in 1993 to 63% in 2007. This shift to longer survival emphasizes the importance of considering the medium- and long-term effects of cancer on survivors' labour market outcomes and financial well-being. For example, Bradley, Bednarek and Neumark (2002a, 2002b), Bradley et al. (2005, 2007b) and Bradley, Oberts and Schenk (2006) use data from the Health and Retirement Study (HRS) and small samples of breast and prostate cancer survivors to estimate the effects of cancer diagnoses on patients' labour supply and earnings. For Canada, Jeon (2014) finds a substantial decrease in earnings among cancer survivors.

When an individual experiences a negative health shock, the labour supply of his or her spouse is subjected to two opposing forces. First, the spouse's labour supply may increase to make up for the sick individual's lost income. This "added worker effect" has been documented after non-health related job losses (e.g., Stephens 2002). In the United States, access to employer-sponsored health insurance provides an additional incentive for the healthy spouse to continue working or increase labour supply (Bradley et al. 2007a). By using data from Canada, which has a universal health care system, this reason for changing spousal labour supply after a health shock can be disregarded and therefore lower added-worker effects can be expected. The Canadian environment also limits the role of selection into health insurance plans and hence makes it more straightforward to give causal interpretation to this study's results. Moreover, these findings may shed light on the effect of cancer diagnoses on spousal labour market outcomes in most European countries with universal health care systems.

Second, family members, and spouses in particular, may reduce their labour supply in order to care for their sick spouses diagnosed with cancer. The "caregiver effect" has been generally documented in situations where one family member requires long-term care and another family member acts as an informal caregiver (see Van Houtven, Coe and Skira 2013; Heger 2014; and Skira 2015). Healthy spouses may also reduce their labour supply if both spouses wish to spend more leisure time together after a cancer diagnosis (complementarity of leisure). Which of the two potential effects dominates is theoretically ambiguous. In this paper, this question is answered empirically in the context of spousal cancer diagnoses among Canadians.

There are two main challenges to analyzing the effects of changes in one spouse's health status on the other spouse's labour supply decisions. The first one is data availability. Analyzing the effects of individuals' health shocks on their family members requires that families in the data be identified. This is relatively easy in household-level survey data. However, the number of individuals suffering from severe health problems that can change families' economic well-being

1. See https://www.cancer.ca/en/cancer-information/cancer-101/cancer-statistics-at-a-glance/?region=on.

is usually small in such surveys. A considerably larger number of individuals with severe health conditions can be observed in administrative data (such as hospital records), but information about family members in such data is usually unavailable. To deal with these problems, this study uses a unique data set linking data from several Canadian administrative sources. In addition to containing a large number of individuals suffering from a health problem (specifically, who were diagnosed with cancer), this study identifies married couples and examines their labour market outcomes.

The second challenge is methodological. In particular, it is related to the interpretation of the estimates. While the effects of one spouse's ill health on the other spouse's earnings (or income) can be easily estimated, finding causal links between the former and the latter is usually a much harder task. Family formation is not random—couples are matched based on observable and unobservable characteristics that also affect the health and earnings of the spouses later in life. An obvious example is the correlation in couples' attitude towards a healthy lifestyle (e.g., spouses are likely to have a similar attitude towards smoking) and their health outcomes. This study controls for time-invariant unobserved heterogeneity by including individual or couple fixed effects in the regression models. In addition, changes in individuals' health status may not occur independently of their own or their spouses' labour supply and income even conditional on individual fixed effects (i.e., they may not be strictly exogenous). For example, it is possible that one spouse's job loss leads to the other spouse's psychological stress, and subsequently to mental or physical health problems. This study uses cancer diagnoses as an example of a substantial and unanticipated, hence strictly exogenous, health shock. It is unlikely that one spouse's labour supply or work preferences directly or indirectly affect the other spouse's likelihood of a cancer diagnosis. Therefore, these findings can provide a causal interpretation.

Given these challenges, only a small number of studies have investigated the effect of changes in one spouse's health status on the other spouse's labour supply. Hollenbeak, Short and Moran (2011) use survey data on spouses of cancer survivors in Pennsylvania matched to a control group drawn from the Panel Study of Income Dynamics. They find a decrease in wives' employment but no effect for husbands. The sample of cancer survivors is not nationally representative and labour supply is self-reported. Nahum (2007) finds evidence for caregiver effects using Swedish administrative data on spouses' sickness absence. She also finds a more pronounced negative effect among wives. Coile (2004) uses data from the HRS to analyze the effect of health shocks and finds small added-worker effects for husbands but not for wives. Given the decrease in the earnings of the sick spouse, this result implies that the household's financial situation significantly deteriorates after one spouse's health shock. In a recent article, García-Gómez et al. (2013) use administrative data from the Netherlands to analyze the effects of individuals' hospitalizations on their own and their spouses' labour market outcomes. They find no significant effects for wives and negative effects for husbands of sick individuals.

This study contributes to the literature by providing new evidence on the effect of severe health shocks on spousal employment and earnings and family income. In contrast to most of the existing literature, it combines objective health shock measures from the Canadian Cancer Registry with administrative and nationally representative earnings data from Canadian longitudinal income tax records. In particular, this study's health shock measure differs from what other studies have used. For example, García-Gómez et al. (2013) and others use acute hospitalizations as a measure for health shocks, but an individual could have experienced declining health prior to being hospitalized. Hence, it is not clear that a hospital admission constitutes an unanticipated shock. In contrast, this study uses an individual's cancer diagnosis to measure a sudden and unanticipated change in a person's health status. It is unlikely that an individual and his or her spouse adjust their labour market behaviour because they are aware of the illness before the diagnosis. Besides using this novel source of exogenous variation in individuals' health, this study combines matching methods with a generalized difference-in-differences (DID) strategy to control for observed and unobserved heterogeneity. Coarsened Exact Matching (CEM) is first applied to the data to make the treatment group (individuals whose spouses have been diagnosed with

cancer) and the control group (individuals whose spouses have never been diagnosed with cancer) observably similar. To make the DID approach more robust, individual fixed effects are included. The study data and methods allow the estimation results to be interpreted in a causal manner, which is essential for an informed policy discussion.

To preview this study's findings, the estimates show that both men and women reduce their employment rates by about 2.4 percentage points in the years following their spouse's cancer diagnosis. Since women have lower average employment rates, this decrease represents a larger relative decline for them. Furthermore, annual earnings decrease by about $2,000 among men and $1,500 among women. In relative terms, this decline corresponds to 3.4% and 5.9% for men and women, respectively. Finally, substantial decreases in family income—which are due to lower earnings among individuals diagnosed with cancer and an additional decline in earnings among their spouses—are estimated. For men whose wife was diagnosed with cancer, family income decreases by up to 4.8% while the reduction for women amounts to 8.5%.

The rest of this paper is organized as follows: Section 2 describes the multiple data sources and how they are combined; Section 3 discusses the empirical strategy; Section 4 explores the estimation results; and Section 5 concludes.

2 Data

The data used in this paper come from five administrative sources and are combined in the 1991 Census–LWF linkage data. The sources include the Canadian 1991 Census of Population, the Canadian Cancer Database (CCDB), the Canadian Mortality Database (CMDB), the LWF, and the T1 Family File (T1FF). The LWF and the T1FF are derived from individual tax returns. A brief description of each data source is provided in Appendix 1.

Statistics Canada linked these data sources in multiple steps. Initially, selected personal information from the CMDB and CCDB was linked to individual records of those 25 and over in the 1991 Census file.[2] This initial data linkage is called the '1991 Canadian Census Cohort: Mortality and Cancer Follow-Up.' Individuals' death records up to 2006 and individuals' cancer records up to 2003 were initially obtained from both the CMDB and CCDB.[3] Subsequently, the 1991 Census cohort was linked to the LWF, which is a random 10% sample of Canadian tax return files from 1983 onward, to create a subset of the data containing demographic characteristics, cancer diagnoses and death records, as well as longitudinal individual income profiles. More recently, spousal and total family incomes from the T1FF have also been added to the 1991 Census–LWF data. The current version of the data includes incomes of individuals, incomes of their spouses, and total family income from 1983 to 2010. In addition to death records from the CMDB, income tax files also provide information about individuals' death years up to 2010.[4] The final 1991 Census–LWF linkage data represent approximately 1.4% of the Canadian population aged 25 and over as of 1991.

The 1991 Canadian Census Cohort: Mortality and Cancer Follow-Up can be used to track cancer histories until 2003 of those who were married to individuals enumerated in the 1991 Census–LWF. Their death records are available up to 2006. However, the marital status of individuals in the 1991 Census–LWF data can change over time. To study the impact of their spouse's cancer diagnosis on these individuals' labour market outcomes, it first had to be verified that they were

2. At that stage, the linkage was based on Statistics Canada's probabilistic record linkage methods. See Wilkins et al. (2008) for detailed information on the data linkage. At the second stage, the LWF data were linked to the 1991 Census cohort using a deterministic record-linkage process based on social insurance numbers.
3. Further data development extending the information on the 1991 Census cohort to more recent years is currently in progress. Detailed information about the 1991 Census and both databases is available from the Statistic Canada website (www.statcan.gc.ca).
4. Death records in the tax data capture about 80% of deaths.

still married to the person who was identified as their spouse in the 1991 Census at the time their spouse was diagnosed with cancer. Before the study sample was selected, continuously married couples had to be identified. To that end, the following steps were taken. For 1991, all married individuals aged 59 and under were selected and only individuals never diagnosed with cancer up to the end of 1991 were retained. In this paper, these people will simply be referred to as "individuals" and their spouse will be called "spouse."[5] Individuals were dropped if their spouse was aged 60 or over in 1991 or if their spouse had been previously diagnosed with cancer. Next, individuals' marriage spells were constructed using family status information from the annual T1FF. In any year, individuals are treated as being continuously married to the same spouse if their marital status has not changed between any two consecutive years from 1991 to that year. If individuals separate, their marriage spell ends. However, in the event the spouse dies, the marriage spell is coded as continued until the individual is remarried, hence widows and widowers are retained in the sample as long as they do not remarry. Once all continuous spells from 1991 onward are identified, changes in individuals' marital status from 1991 back to 1983 are tracked in order to identify the starting year of the continuous marriage spells. Within the identified continuous marriage spells that span years before and after 1991, individuals are presumed to have been married to the person identified as their spouse in the 1991 Census.[6]

The marriage spell data contain 107,921 married individuals aged 59 and under in 1991 whose spouse was also aged 59 and under in 1991 and both of whom had no cancer history prior to 1992. The average length of the marriage spells that cover part of or the whole period from 1983 to 2010 is 21.4 years, and 94% of the spells are 10 years or longer. The average age of the individual is 39.7 years in 1991 and the average age of their spouse is 39.8 years. Spouses of 3,665 individuals were diagnosed with cancer for the first time between 1992 and 2003. The age of these individuals at the time of their diagnosis ranges from 28 to 64 years.

In the next step, further restrictions were imposed on the marriage spell data to obtain the treatment and control samples for this study. In each year $t = 0$ from 1992 to 2003, individuals who had yet to reach the age of 60 were selected so they would still be of working age. The same age restriction was imposed on the spouse. Individuals who were never diagnosed with cancer up to the end of year $t = 0$ and who lived for at least five years following year $t = 0$ were kept regardless of the length of their marriage spells.[7] The sample is restricted to individuals whose employment status (working or not) can be determined in at least two years prior to year $t = 0$. The individuals are presumed to have worked in each year in which they had non-zero annual earnings.[8] The treatment group that satisfies these restrictions consists of 2,636 individuals (1,501 men and 1,135 women) whose spouses were diagnosed with cancer for the first time from 1992 to 2003.[9] The most common cancer sites for male spouses are prostate (16.7%) and lung and bronchus (12.7%), and the most common for female spouses are breast (39.2%) and cervix uteri (11.8%). The control sample consists of individuals whose spouse was not diagnosed with cancer at any time from 1992 to 2003. In the control sample, individuals satisfying the above sample

5. That is, for the terminology used in this study, "spouses" are those persons who were diagnosed with cancer between 1992 and 2003, and "individuals" are those persons whose labour market outcomes are considered.
6. At this stage, 112,410 continuous marriage spells were identified—4,489 individuals with earnings below 0.25% and above 99.75% of the earnings distribution in any year were dropped from the sample to remove the influence of positive and negative outliers (extreme earners) in the tax data. The bottom and top income cut-off points are -$8,818.90 for 0.25% and $377,701 for 99.75%.
7. This study's data allow for individuals in treatment and control samples to be diagnosed with cancer in later years. The number of individuals diagnosed with cancer within the spousal post-cancer study period in the final matched treatment sample is 34 (21 males and 13 females).
8. Annual earnings are defined as the sum of all wages and salaries received in a given year plus the net self-employment income for that year. All monetary amounts are in 2010 dollars.
9. Of the 3,665 individuals initially identified as having spouses diagnosed with cancer for the first time from 1992 to 2003, 864 were dropped from the sample because of age restrictions in the year of the spouse's cancer diagnosis. An additional 88 were dropped because their marriage spells ended in the year of the diagnosis; 43 were dropped because they were diagnosed with cancer before their spouse; 22 were dropped because they died within the next five years, and 12 were dropped because their work status could not be determined for the previous two years.

restrictions in each year $t = 0$ may appear more than once. The total number of observations from 1992 to 2003 in the control sample is 932,970 (450,763 for men and 482,207 for women). This is the pooled number of observations for 100,449 individuals (48,583 men and 51,866 women).

The analysis is conducted separately for men and women because male and female age profiles of labour supply differ. The sample is not restricted to individuals who worked prior to their spouse's cancer diagnosis to allow for the inclusion of all possible changes in employment due to a spousal health shock.[10]

Table 1 shows differences in the characteristics of the treatment and control samples for men (Columns 1 and 2) and women (Columns 6 and 7). The same patterns are observed for both men and women. The most notable difference is in the average ages between the treatment and control samples.[11] Individuals in the treatment sample are older than those in the control sample. The age differences also seem to be associated with differences in other characteristics. Individuals in the treatment sample are less likely to work but, on average, their annual earnings and total family income are higher than those of their counterparts in the control sample. They have fewer children at home and the youngest child in the treatment sample is generally older than in the control sample. For both men and women, there are also fewer members of visible minorities among the treatment sample than among the control sample. Not surprisingly, individuals' age is positively correlated with the probability of their spouse's cancer diagnosis and their own labour supply. However, other differences in the characteristics of the treatment and control samples such as the number of children and family income can be also highly associated with individuals' labour supply decisions.

In order to balance the covariates shown in Table 1 between treatment and control samples, CEM is first applied to the data before estimating the effect of spousal cancer diagnoses on individuals' employment and earnings. The next section describes the matching approach.

10. This study does not explicitly examine transitions between full- and part-time employment or measure other changes in working hours. Only annul earnings are observable in the tax data; employment status (worked or not) was generated based on having non-zero annual earnings. Implicitly, changes in working hours or other changes in employment are present in the changes in annual earnings after the spousal cancer diagnosis.
11. Age is the only variable for which the normalized difference exceeds the rule-of-thumb value of 0.25 (Imbens and Wooldridge 2009). The normalized difference for covariate X is defined as $(\overline{X}_T - \overline{X}_C)/\sqrt{S_T^2 + S_C^2}$, where $\overline{X}_T$ and $\overline{X}_C$ are the sample means and S_T^2, S_C^2 are the sample variance for the treatment and control groups, respectively.

Table 1-1
Summary statistics for pre-matched and matched samples — Part 1 of 3

	Men					Women				
	Pre-matched sample			Matched sample		Pre-matched sample			Matched sample	
	Treatment group	Control group	Normalized difference	Treatment group	Control group	Treatment group	Control group	Normalized difference	Treatment group	Control group
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
	mean		normalized difference		mean			normalized difference	mean	
Age (mean) at $t = 0$	48.365	45.221	0.301	48.328	48.232	48.211	42.993	0.539	48.084	47.927
	fraction		normalized difference		fraction			normalized difference	fraction	
Coarsened age at $t = 0$										
25 to 29	x	x	0.053	x	x	x	x	0.114	x	x
30 to 34	x	x	0.094	x	x	x	x	0.242	x	x
35 to 39	0.091	0.166	0.159	0.085	0.085	0.076	0.209	0.274	0.079	0.079
40 to 44	0.153	0.218	0.119	0.155	0.155	0.160	0.236	0.135	0.160	0.160
45 to 49	0.211	0.216	0.008	0.222	0.222	0.256	0.208	0.080	0.262	0.262
50 to 54	0.256	0.182	0.127	0.259	0.259	0.300	0.149	0.259	0.300	0.300
55 to 59	0.241	0.133	0.197	0.232	0.232	0.178	0.063	0.253	0.168	0.168
Highest level of schooling										
No high school	0.243	0.238	0.007	0.239	0.239	0.280	0.225	0.090	0.273	0.273
High school – with/without trades	0.428	0.425	0.004	0.444	0.444	0.409	0.409	0.000	0.440	0.440
Postsecondary non-university	0.147	0.158	0.020	0.131	0.131	0.188	0.218	0.053	0.174	0.174
University degree	0.183	0.179	0.006	0.187	0.187	0.123	0.148	0.052	0.113	0.113
Visible minority										
Non minority	0.928	0.914	0.036	0.967	0.967	0.940	0.919	0.058	0.974	0.974
Asian	0.049	0.060	0.036	0.027	0.027	0.042	0.060	0.056	0.022	0.022
Other	0.023	0.025	0.009	0.007	0.007	0.018	0.022	0.020	0.004	0.004
Province/territory at $t = 0$										
Newfoundland	0.022	0.023	0.003	0.009	0.009	0.026	0.031	0.018	0.022	0.022
Prince Edward Island	x	0.005	0.012	x	x	0.004	0.006	0.012	0.000	0.000
Nova Scotia	0.048	0.033	0.052	0.037	0.037	0.033	0.032	0.002	0.027	0.027
New Brunswick	0.029	0.027	0.008	0.022	0.022	0.026	0.026	0.003	x	x
Quebec	0.268	0.259	0.015	0.299	0.299	0.244	0.236	0.014	0.264	0.264
Ontario	0.303	0.355	0.078	0.340	0.340	0.353	0.352	0.002	0.392	0.392
Manitoba	0.031	0.042	0.039	0.024	0.024	0.043	0.042	0.004	0.038	0.038
Saskatchewan	0.037	0.037	0.000	0.028	0.028	0.028	0.036	0.032	0.025	0.025
Alberta	0.118	0.092	0.060	0.119	0.119	0.085	0.097	0.028	0.078	0.078
British Columbia	0.127	0.108	0.040	0.118	0.118	0.117	0.109	0.018	0.108	0.108
North West Territories	x	0.005	0.048	0.000	0.000	0.004	0.006	0.014	x	x
Yukon	x	0.002	0.022	0.000	0.000	0.000	0.001	0.036	0.000	0.000
Missing	0.009	0.012	0.024	x	x	0.034	0.027	0.032	0.027	0.027

x suppressed to meet the confidentiality requirements of the *Statistics Act*

Notes: The pre-matched sample consists of all individuals, and the matched sample consists of individuals for whom a match in the treatment or control group could be found. The sample averages for the matched sample are weighted by the Coarsened Exact Matching weights (see text for details). The year of spousal cancer diagnosis is $t = 0$. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Table 1-2
Summary statistics for pre-matched and matched samples — Part 2 of 3

	Men					Women				
	Pre-matched sample			Matched sample		Pre-matched sample			Matched sample	
	Treatment group	Control group	Normalized difference	Treatment group	Control group	Treatment group	Control group	Normalized difference	Treatment group	Control group
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
	fraction		normalized difference		fraction			normalized difference	fraction	
Year at t = 0										
1992	0.088	0.105	0.041	0.090	0.090	0.067	0.105	0.095	0.071	0.071
1993	0.079	0.103	0.060	0.081	0.081	0.087	0.103	0.038	0.094	0.094
1994	0.078	0.098	0.051	0.080	0.080	0.083	0.098	0.038	0.082	0.082
1995	0.079	0.094	0.037	0.072	0.072	0.093	0.094	0.001	0.087	0.087
1996	0.089	0.089	0.001	0.089	0.089	0.076	0.089	0.035	0.070	0.070
1997	0.075	0.085	0.025	0.075	0.075	0.081	0.085	0.010	0.079	0.079
1998	0.095	0.081	0.036	0.101	0.101	0.103	0.081	0.054	0.091	0.091
1999	0.099	0.077	0.054	0.100	0.100	0.092	0.077	0.038	0.101	0.101
2000	0.091	0.073	0.046	0.088	0.088	0.080	0.073	0.019	0.089	0.089
2001	0.085	0.069	0.041	0.081	0.081	0.094	0.069	0.064	0.095	0.095
2002	0.073	0.065	0.022	0.074	0.074	0.065	0.065	0.001	0.060	0.060
2003	0.070	0.061	0.026	0.068	0.068	0.078	0.061	0.048	0.081	0.081
Number of children at t = -1										
No dependant	0.292	0.196	0.159	0.320	0.320	0.321	0.192	0.210	0.338	0.338
1	0.268	0.232	0.060	0.258	0.258	0.243	0.227	0.026	0.224	0.224
2	0.310	0.385	0.112	0.310	0.310	0.314	0.389	0.112	0.323	0.323
3 and more	0.129	0.187	0.113	0.112	0.112	0.122	0.191	0.134	0.116	0.116
Age of the youngest child at t = -1										
No dependent	0.292	0.196	0.159	0.320	0.320	0.321	0.192	0.210	0.338	0.338
0 to 6 years of age	0.147	0.237	0.163	0.129	0.129	0.078	0.240	0.320	0.069	0.069
7 to 17 years of age	0.331	0.411	0.117	0.325	0.325	0.338	0.414	0.110	0.338	0.338
18 years of age and older	0.230	0.157	0.132	0.227	0.227	0.263	0.154	0.191	0.255	0.255
	dollars		normalized difference		dollars			normalized difference	dollars	
Total family income at t = -1 (mean)	100,340	94,046	0.080	104,532	102,596	102,320	98,389	0.031	105,909	105,472
	percent		normalized difference		percent			normalized difference	percent	
Quintiles of earnings at t = -1										
Lowest	0.175	0.200	0.046	0.148	0.148	0.192	0.200	0.014	0.171	0.171
Second	0.175	0.200	0.046	0.176	0.176	0.189	0.200	0.019	0.184	0.184
Third	0.215	0.200	0.025	0.209	0.209	0.181	0.200	0.033	0.184	0.184
Fourth	0.205	0.200	0.009	0.213	0.213	0.204	0.200	0.008	0.208	0.208
Highest	0.231	0.200	0.054	0.254	0.254	0.233	0.200	0.056	0.253	0.253

Notes: The pre-matched sample consists of all individuals, and the matched sample consists of individuals for whom a match in the treatment or control group could be found. The sample averages for the matched sample are weighted by the Coarsened Exact Matching weights (see text for details). The year of spousal cancer diagnosis is t = 0. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Table 1-3
Summary statistics for pre-matched and matched samples — Part 3 of 3

	Men					Women				
	Pre-matched sample			Matched sample		Pre-matched sample			Matched sample	
	Treatment group	Control group	Normalized difference	Treatment group	Control group	Treatment group	Control group	Normalized difference	Treatment group	Control group
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
	percent		normalized difference		percent			normalized difference	percent	
Share of earnings in the total family income at t = -1 > 50%	0.568	0.613	0.064	0.609	0.609	0.123	0.134	0.233	0.107	0.107
Working at t = -1	0.931	0.938	0.020	0.960	0.960	0.791	0.808	0.029	0.834	0.834
Working at t = -2	0.932	0.943	0.033	0.971	0.971	0.804	0.809	0.010	0.844	0.844
	dollars		normalized difference		dollars			normalized difference	dollars	
Earnings at t = -1 (mean)	54,665	53,126	0.028	59,118	57,347	26,443	26,255	0.005	28,612	27,883
Earnings at t = -2 (mean)	55,140	53,092	0.038	59,522	57,746	26,700	25,788	0.025	28,803	27,717
					number					
Total number of observations	1,501	450,763	...	1,195	14,365	1,135	482,207	...	924	13,144

... not applicable

Notes: The pre-matched sample consists of all individuals, and the matched sample consists of individuals for whom a match in the treatment or control group could be found. The sample averages for the matched sample are weighted by the Coarsened Exact Matching weights (see text for details). The year of spousal cancer diagnosis is t = 0. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

3 Empirical strategy

3.1 Matching

To balance treatment and control group covariates, CEM is used—a multidimensional exact matching algorithm applied to cells generated by dividing continuous variables into discrete intervals or by regrouping categorical variables into fewer coarsened categories.[12] The CEM algorithm creates a set of strata with the same coarsened values of matching variables; it also restricts the matched data to areas of common empirical support by pruning unmatched observations from both the treated and control samples. For each stratum, the CEM algorithm returns weights $(n_t / n_c \times N_c / N_t)$ that can be used to reweight observations in the matched control sample and balance the empirical distributions of the matching variables between the two samples.[13] Later, these matching weights are used in the regression analysis of work status, annual earnings and family income.[14]

Increasing the number of matching dimensions by adding extra matching variables decreases the probability of finding matches between the treatment and control because the CEM requires exact matching in all coarsened categories of the matching variables. Therefore, it is ideal to have a relatively small set of matching variables sufficient to control for observable differences between the treatment and control samples and, at the same time, small enough to reduce the number of unmatched individuals from the treatment sample. Here the set of matching variables includes individuals' own and family characteristics, but spouses' characteristics are not included in the matching variables.[15] The personal and family characteristics of individuals chosen as matching variables are likely to be direct determinants of individuals' labour market outcomes before and after their spouses' cancer diagnoses. Matching on these variables therefore controls for selection on observables in the outcome variables of interest, which are individuals' employment, earnings and family income.

Individuals in the treatment and control samples are matched using pooled data from 1992 to 2003 with calendar years used as one of the matching variables. The matching variables also include age (coarsened into 5-year intervals), education, visible minority status (coarsened to three categories), and province of residence. Family characteristics included in the matching variables are the number of children in the family (coarsened to four categories), age of the youngest child (coarsened to three categories), and total family income in the previous year

12. The CEM method reduces all imbalances related to the first and higher moments, nonlinearities, interactions, and other multidimensional distributional differences between the treated and control groups. See Iacus, King and Porro (2012) and Iacus, King and Porro (2011) for a detailed discussion of CEM properties and comparison with other matching methods. Similar results are obtained by applying propensity score weighting and these estimates are provided in Appendix 2.
13. Weights assigned to the matched control sample will be equal to the ratio of the treatment sample size (n_t) to the control sample size (n_c) in each stratum multiplied by the ratio of the total size of the control sample (N_c) to the total size of the treatment sample (N_t). The weights for the matched treatment sample are equal to 1. The weights for unmatched records are set to 0.
14. Ho et al. (2007) demonstrate that preprocessing raw data using matching procedures turns parametric models into a much more reliable tool of the empirical analysis of causal effects; in particular, estimates of causal effects are less sensitive to the choice of model specification. One of the proven properties of the CEM is that it reduces the degree of model dependence (Iacus, King and Porro 2012). Model dependence is defined by how much the predicted value of the outcome variable varies as a function of the statistical model for a given set of explanatory variables (Ho et al. 2007). One of the key reasons for matching is to eliminate model dependence; however, it has never been proven mathematically for any previous matching methods commonly used in the various analyses. For a detailed discussion, see Iacus, King and Porro (2011).
15. Spouses' observable characteristics associated with cancer incidence such as age, education and visible minority status are also correlated with those of individuals because of assortative mating. Individuals' own characteristics are more likely to be direct determinants of their labour market outcomes before and after their spouses' cancer diagnoses.

(coarsened to quintiles). The share of the individual's earnings in the total family income in the previous year (coarsened to two categories) is also included as a matching variable to account for the individual's earnings contribution to the total family income prior to the spouse's cancer diagnosis. To account for individuals' attachment to the labour market prior to their spouse's cancer diagnosis, the first and second lags of their employment status (i.e., working or not working) are also included as matching variables.

Columns 4, 5, 9, and 10 in Table 1 show the characteristics of the matched samples for men and women in the treatment and control samples, respectively. Not all individuals in the treatment sample could be matched to comparable individuals in the control sample. For 306 men (20.4%) and 211 women (18.6%) in the treatment samples, no comparable matches could be found in the control samples. Most characteristics of unsuccessful matches among men and women in the treatment samples are very similar. Those in the treatment sample who did not work in the two years prior to their spouse's cancer diagnosis have a smaller chance of being matched to someone in the control sample than those who worked in those two years. Consequently, the matched individuals in the treatment sample have higher average individual earnings and total family income than individuals in the pre-matched treatment sample shown in Columns 1 and 6 of Table 1. Individuals not identified as a visible minority in the treatment samples are more likely to be matched with someone from the control samples than those identified as a visible minority. However, other characteristics such as average age, education, and age of the youngest child are similar for the pre- and post-matched treatment samples. Overall types of spousal cancer are also similar in the pre- and post-matched treatment samples. The types of spouses' cancer in the matched treatment samples are presented in Table 2 for both male and female spouses.

Finally, comparing Columns 4 and 5 for men and 9 and 10 for women, respectively, in Table 1 shows how similar the characteristics of the matched treatment and the matched CEM-weighted control samples are. There are virtually no differences in characteristics between the two matched samples with matching weights.

As the final step, a regression sample for the matched individuals in the treatment and control samples is constructed. The year of the spouse's first cancer diagnosis is year $T = \{1992, \ldots, 2003\}$ and t is the number of years elapsed from the year of the diagnosis ($t = 0$ in year T). In the matched control sample, t can be equal to 0 in any year from 1992 to 2003 depending on the T in the matched treatment sample, so that $t = 0$ is the same year in both samples. Individuals' longitudinal profiles are constructed from $t = -5$ to $t = 5$ as long as these time periods fall within individuals' continuous marriage spells.[16]

16. These reconstructed panel data do not constitute a balanced panel. The lengths of the spells vary from 4 to 11 consecutive years. See Subsection 3.2 for more details.

Table 2
Distribution of spousal cancer sites for men and women

	Men (female spouses)		Women (male spouses)	
	Pre-matched	Matched	Pre-matched	Matched
		percent		
High survival category				
Thyroid	4.13	4.18	2.64	2.60
Prostate	0.00	0.00	16.65	17.21
Testis	0.00	0.00	2.47	2.60
Skin melanoma	4.13	4.44	5.99	6.28
Breast	39.17	39.41	x	x
Corpus uteri	4.40	3.85	0.00	0.00
Hodgkin lymphoma	0.67	0.84	1.23	1.41
Medium survival category				
Chronic lymphocytic leukemia	x	x	0.79	0.97
Cervix uteri	11.79	11.46	0.00	0.00
Bladder (including in situ)	1.07	1.09	5.20	5.74
Kidney and renal pelvis	1.40	1.51	3.96	4.44
Soft tissue	0.60	0.59	1.06	1.08
Larynx	x	x	1.06	0.97
Rectum	2.33	2.34	5.90	5.63
Colon	3.86	4.10	7.75	7.25
Non-Hodgkin lymphoma	3.13	3.01	6.26	6.28
Oral (buccal cavity and pharynx)	1.33	1.34	3.96	3.79
Low survival category				
Ovary	3.33	3.01	0.00	0.00
Multiple myeloma	0.87	0.67	1.67	1.62
Leukemia (excluding chronic lymphocytic leukemia)	1.33	1.26	1.50	1.30
Stomach	0.53	0.50	2.73	2.71
Brain	1.40	1.42	2.82	2.71
Liver	x	x	x	x
Lung and bronchus	5.86	6.69	12.69	12.45
Esophagus	x	x	1.06	1.08
Pancreas	x	x	1.41	1.62
Other	7.53	7.28	9.87	9.31
		number		
Total number of spousal cancers	1,501	1,195	1,135	924

x suppressed to meet the confidentiality requirements of the *Statistics Act*

Note: Distribution in percentages for all spousal cancer diagnoses. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

3.2 Generalized difference-in-differences regressions with individual fixed effects

To control for time-invariant unobservable individual characteristics potentially correlated with individuals' labour market outcomes and their spouses' health behaviour, a DID model with individual fixed effect model is applied.[17] The effects of one spouse's cancer diagnosis on the other spouse's labour market outcomes are allowed to vary over time (generalized DID). The results from these regressions can be interpreted as causal effects when combined with strictly exogenous health shocks, specifically cancer diagnoses.

Matching and DID are combined by estimating a fixed effect model with interactions between Treatment group (C) and time (T) dummies and applying the CEM matching weights in the

17. Couples' observable characteristics such as age, education and visible minority status can be correlated with each other (assortative mating). Furthermore, spouses' unobservable health behaviour such as smoking, diet and exercise may also be correlated.

estimation (Jacobson, LaLonde and Sullivan 1993; Hijzen, Upward and Wright 2010; Boden and Galizzi 2003) as follows:

$$Y_{it} = \alpha_i + X'_{it}\beta + \sum_{k=-5}^{k=5} \gamma^k T_{it}^k + \sum_{k=-5}^{k=5} \delta^k C_i T_{it}^k + \epsilon_{it}, \quad (1)$$

where Y_{it} is the labour market outcome variable (work status, annual earnings or family income) for individual i in time period t. The time-invariant individual fixed effect is α_i. Vector X_{it} consists of individuals' time-varying characteristics. Each T_{it}^k is a dummy variable equal to 1 if $t = k$ and 0 otherwise. C_i is a dummy equal to 1 if the individual's spouse was diagnosed with cancer and 0 otherwise (treatment dummy). The reference period is $t = -1$. Hence, δ^k is an estimate of the difference in Y_{it} between treatment and control groups in different time periods t relative to the difference in Y_{it} between the two groups at $t = -1$ (which is a year prior to the year of the spouse's cancer diagnosis). In other words, δ^k is the generalized DID effect of spousal cancer on individuals' labour market outcomes for time period k after the cancer diagnosis.

In order for the DID parameters to have a causal interpretation, the pre-trends of the outcome variables have to be similar between treatment and control groups. That is to say the δ^k have to be close to 0 and not significant for $k < -1$. Since data on individuals' labour market outcomes before the (placebo) cancer diagnosis are available, this common trends assumption can be easily tested. See Subsection 4.1 for graphical evidence for this assumption.

Individual panels are unbalanced as the start and end of the continuous marriage spell can differ for different individuals. However, all marriage spells are continuous. The length of individual panels varies from 4 to 11 consecutive time periods. The sample restrictions described in Section 2 imply that the minimum number of time periods in individual panels is 4 since each panel includes at least the time periods $-2 \leq t \leq 1$. One male individual in the treatment group and five people (one male and four females) in the control groups are present in the sample for only 4 time periods. Overall, 83% of individuals in the treatment groups (82% males, 86% females) and 92% of the control groups (92% males, 93% females) have 11 full time periods of data.

In addition to the generalized DID regressions (1), basic DID regressions that restrict the effect of spousal cancer diagnoses to be constant over time are also run:

$$Y_{it} = \alpha_i + X'_{it}\beta + \gamma T_{it} + \delta C_i T_{it} + \epsilon_{it}, \quad (2)$$

where δ is the coefficient of interest. Regressions (2) are also used to estimate the effects of specific cancer diagnoses (e.g., lung, colon, breast, and prostate cancer) on spousal employment and earnings. Because of smaller sample sizes, there is not enough statistical power to estimate time-specific effects δ^k. As in Equation (1), the CEM weights are also applied to the regressions in Equation (2). In combination with individual fixed effects, the coefficient δ can therefore be interpreted as a causal parameter.

4 Results

4.1 Graphical evidence

Graphs depicting the outcomes of interest are presented before the discussion on the regression results. Each of the following graphs shows annual averages for the treatment group and the control group. These averages are plotted over time relative to the year when the (placebo) cancer diagnosis occurred ($t = 0$) and separately for men and women.[18] In this section, the common trends assumption that is necessary for the difference-in-differences (DID) estimation below is assessed.

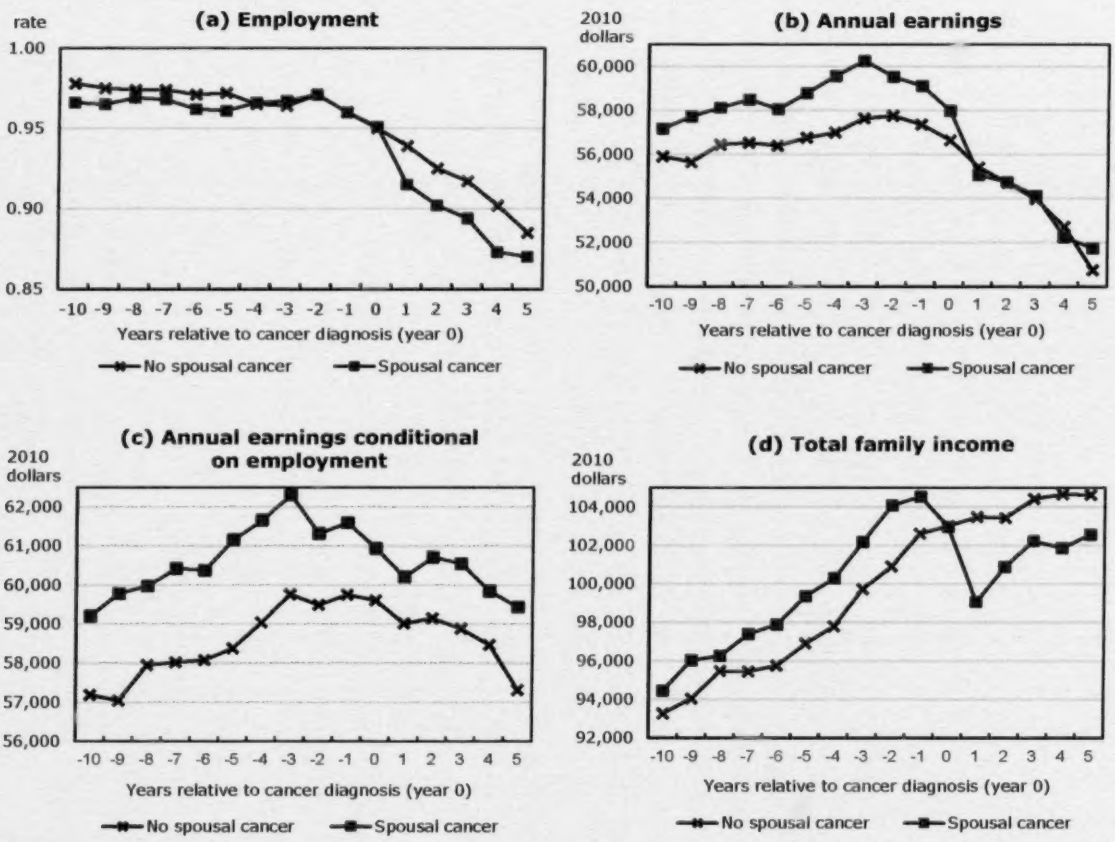
The following four outcomes are considered: employment (defined by non-zero earnings in a given year), annual earnings, annual earnings conditional on employment, and total family income.[19] Chart 1 shows the graphical results for men using the CEM weights. Chart 1-(a) ("Employment") shows clear evidence for a decrease in men's employment after their wives are diagnosed with cancer. One year after the diagnosis, average employment is about 2 to 3 percentage points lower among the treatment group than the control group. This difference remains mostly stable during the five-year follow-up period. To assess the common trends assumption, employment rates across treatment and control groups before the cancer diagnosis are inspected. Weighted employment rates in the two years before the diagnosis are exactly equal because these two variables enter the CEM weights. Going back in time up to 10 years prior to the diagnosis also shows closely aligned trends. In particular, there is no evidence for a dip in employment among the treated, which may have indicated potential endogeneity of the wife's cancer diagnosis with respect to the husband's employment status in the pre-diagnosis period.

Chart 1-(b) ("Annual earnings") shows unconditional annual earnings (i.e., they include men who were not employed in a given year). While earnings prior to the cancer diagnosis are higher among men whose wife is diagnosed with cancer, the trends are roughly similar, and slightly increasing, for both groups. After the cancer diagnosis, earnings of the treated group decline relative to control-group earnings. Hence, the associated DID estimate is negative. With average annual earnings of around $59,000 in the matched treatment group before the cancer diagnosis, this decline amounts to about 3% of annual earnings. Comparing this finding to Chart 1-(c) ("Annual earnings conditional on employment") shows that a large part of the decline in earnings is due to a decrease in labour supply at the extensive margin. When only men who work are included, the DID estimate for annual earnings is about $1,000. Again, men in the treatment group have higher conditional earnings before the diagnosis, but the trend is similar to control-group earnings. Hence, the conclusion is that the caregiver effect dominates the added-worker effect among men whose wife was diagnosed with cancer.

Finally, Chart 1-(d) ("Total family income") (i.e., the joint income of men and their wives diagnosed with cancer, and possibly other household members) is considered. The parallel trends assumption in this case is also verified and a substantial drop in total income among the treatment group following the wife's cancer diagnosis is found. Two years after the diagnosis, this decline reverses a bit, but even five years after the cancer diagnosis, family income is about $4,000 lower among the treated group relative to the pre-diagnosis income difference.

18. As in the remainder of this section, results for men are those where the wife was diagnosed with cancer, and results for women are those where the husband was diagnosed with cancer.
19. Annual earnings and income variables are obtained from individuals' tax returns. Family income is total earned and unearned income of all family members before taxes, including government transfers. After-tax family income would be a better measure of the impact of spousal cancer diagnoses on families' financial well-being than before-tax family income. However, after-tax income is not available for all study periods in the data.

Chart 1
Employment, earnings, and family income for men



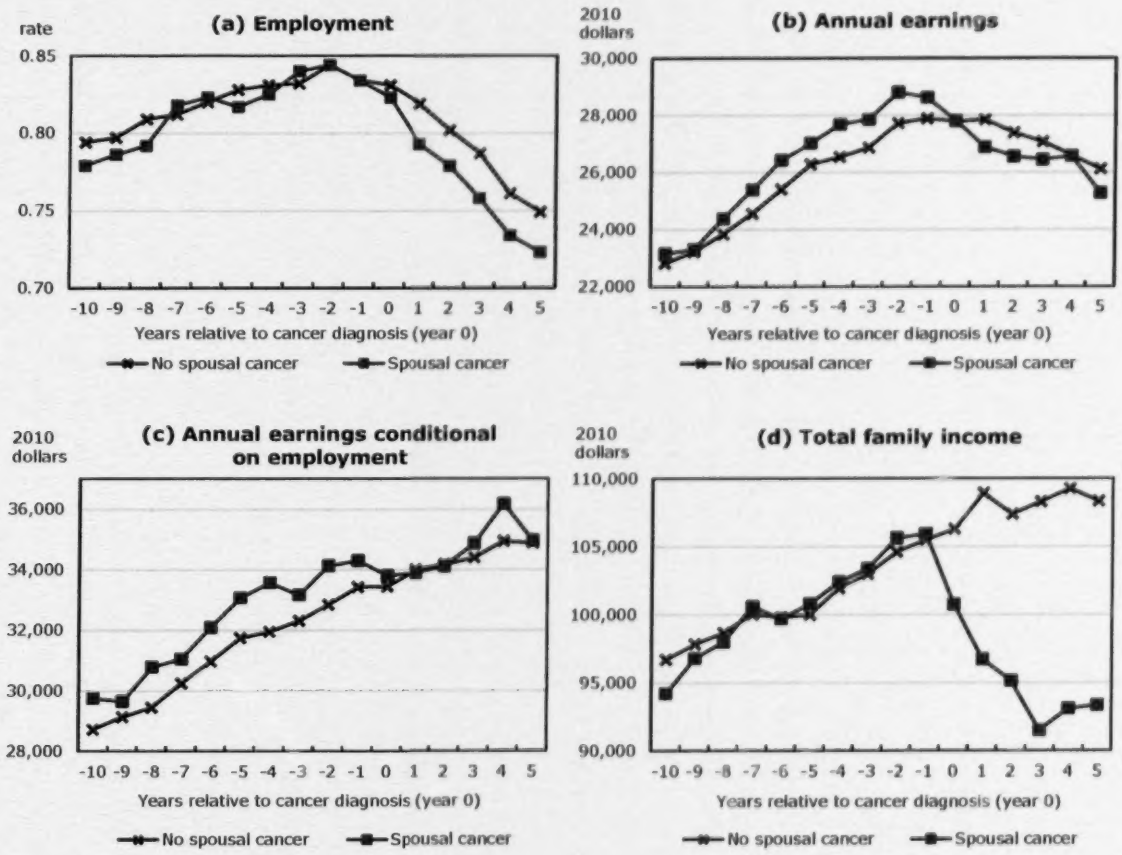
Note: Authors' calculations.
Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Chart 2 contains the same set of results for women. Chart 2-(a) indicates that women reduce their employment by about 2 to 3 percentage points after their husband is diagnosed with cancer. Hence, the raw effects are similar to those for men. Annual earnings among women in the treatment group decrease by about $2,000 compared with the control group. Given the lower earnings levels among women, this drop constitutes a larger relative earnings change for women than men. A smaller decrease is found for earnings conditional on employment than for unconditional earnings, implying that women reduce their labour supply mostly at the extensive margin. Overall, the graphical results show that the caregiver effect dominates among women too.

Finally, family income drops substantially when husbands' cancer diagnoses are considered (Chart 2-[d]). This effect consists of a drop in earnings among the affected husbands, with an added decrease in earnings by women who reduce their labour supply in order to potentially act as caregivers. The negative effect on family income increases over time and reaches about $15,000 (15%) of average annual family income three years after the husband's cancer diagnosis. Hence, a husband's cancer diagnosis has important implications for the financial situation of affected families.

Using the graphs in Chart 2, the common trends assumption for women's labour market behaviour can also be assessed. While the pre-diagnosis employment trend is noisier for the female treatment group than the control group, the assumption overall holds in this case. The two earnings measures also have parallel trends in the treatment and control groups before the (placebo) cancer diagnosis. For family income, annual averages are similar between treatment and control groups before $t = 0$. This result is remarkable since only family income in the year prior to the cancer diagnosis, along with number of children and the age of the youngest child, enters the CEM weights, but the pre-trends are very close for at least seven years before the diagnosis. For this study sample, the variables that enter the CEM algorithm are sufficient to control for observable differences between the treatment and control groups for the extended pre-diagnosis period.

Chart 2
Employment, earnings, and family income for women



Note: Authors' calculations.
Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

4.2 Regression results

In this section, the following sets of results are presented for men's and women's employment (using a dummy variable that equals 1 if an individual has non-zero annual earnings during a given year), annual earnings, and family income: DID regressions with time-invariant effects (Tables 3 and 4); generalized DID regressions with time-varying effects (Tables 5 to 10 show the main results); the same set of results restricting the sample to individuals whose spouse survived at least five years after their cancer diagnosis (Table 11); and DID regressions for different types of cancer diagnoses (Table 12).

4.2.1 Time-invariant effects

First, regression results from estimating Equation (2) are briefly presented using a standard DID framework with time-invariant effects of spousal cancer diagnoses on labour market outcomes. Tables 3 and 4 contain the results for the following outcomes: employment, annual earnings, and family income for men and women. Three separate regressions—which differ by the definition of the post-diagnosis period—are provided for each outcome. In particular, how time period $t = 0$ (year of the cancer diagnosis) is treated varies as follows: included in the pre-period, included in the post-period, and excluded from the estimation sample. The estimates show that men and women reduce their employment by about 2 percentage points after the cancer diagnosis of their spouse. The decrease is slightly larger among women in both absolute and relative terms. Annual earnings decline by $1,600 to $2,100. Women's earnings decrease less in absolute terms than men's, but more relative to average pre-diagnosis earnings (about 3.4% for men and 5.2% for women). Finally, family income decreases substantially. This reduction is largest among women, where total income declines by about $7,000 (6.5%) relative to pre-treatment levels. Part of this reduction is due to women's decline in earnings, but a larger contribution comes from their husband, whose earnings decline after the cancer diagnosis (see Jeon 2014).

Table 3
Difference-in-differences results for the effect of spousal cancer on men's employment, annual earnings, and total family income

	Employment			Annual earnings			Total family income		
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Post-diagnosis									
Coefficient	-0.048 ***	-0.052 ***	-0.054 ***	-3,359.024 ***	-3,838.320 ***	-3,948.284 ***	7,656.712 ***	7,242.961 ***	8,184.350 ***
Standard error	0.003	0.003	0.004	396.343	402.985	433.663	497.830	502.606	547.616
Spousal cancer × post-diagnosis									
Coefficient	-0.016 *	-0.021 **	-0.021 **	-1,828.960 *	-1,975.056 *	-2,100.747 *	-2,671.934 *	-2,648.783 *	-2,745.355 *
Standard error	0.007	0.007	0.008	887.768	921.186	984.797	1,087.549	1,127.257	1,208.370
Constant									
Coefficient	0.967 ***	0.964 ***	0.967 ***	57,531.642 ***	57,425.714 ***	57,554.443 ***	32,467.622 ***	32,194.389 ***	32,370.952 ***
Standard error	0.002	0.001	0.002	200.650	169.099	200.557	1,544.369	1,557.838	1,605.156
Post-diagnosis period: k = {0,...,5}	y	...	...	y	...	...	y	...	...
Post-diagnosis period: k = {1,...,5}	...	y	y	...	y	y	...	y	y
k = 0 excluded from sample	...	...	y	...	...	y	...	...	y
Family size controls	...	...	...	...	...	...	y	y	y
Number of observations	167,832	167,832	152,272	167,832	167,832	152,272	166,625	166,625	151,065

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

*** significantly different from reference category ($p<0.001$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. The definition of the post-diagnosis period is indicated for each regression (see text for details). The time period of spousal cancer diagnosis is k = 0. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Table 4

Difference-in-differences results for the effect of spousal cancer on women's employment, annual earnings, and total family income

	Employment			Annual earnings			Total family income		
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Post-diagnosis									
Coefficient	-0.042 ***	-0.050 ***	-0.050 ***	86.679	-177.248	-53.529	10,803.979 ***	10,556.739 ***	11,804.420 ***
Standard error	0.005	0.005	0.005	282.088	285.813	309.064	820.770	872.578	941.932
Spousal cancer × post-diagnosis									
Coefficient	-0.020 †	-0.021 †	-0.023 †	-1,490.254 *	-1,460.621 *	-1,607.038 *	-6,850.687 ***	-6,863.828 ***	-7,047.387 ***
Standard error	0.010	0.011	0.012	587.495	599.280	645.484	1,707.094	1,889.237	1,966.138
Constant									
Coefficient	0.834 ***	0.833 ***	0.834 ***	27,118.408 ***	27,234.518 ***	27,122.413 ***	78,187.177 ***	79,347.408 ***	77,671.303 ***
Standard error	0.002	0.002	0.003	143.581	120.558	143.661	1,090.578	1,067.784	1,199.441
Post-diagnosis period: k = {0,...,5}	y	...	...	y	...	...	y	...	...
Post-diagnosis period: k = {1,...,5}	...	y	y	...	y	y	...	y	y
k = 0 excluded from sample	...	...	y	...	...	y	...	...	y
Family size controls	...	...	...	...	...	...	y	y	y
Number of observations	152,087	152,087	138,019	152,087	152,087	138,019	151,094	151,094	137,026

... not applicable

* significantly different from reference category ($p<0.05$)

*** significantly different from reference category ($p<0.001$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. The definition of the post-diagnosis period is indicated for each regression (see text for details). The time period of spousal cancer diagnosis is k = 0. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

4.2.2 Time-variant effects

The main results are presented below (i.e., the results from estimating the generalized DID regressions in Equation (1) separately for men and women). As described in Subsection 3.2, these regressions are estimated using the CEM weights and include individual fixed effects. Each regression is estimated first without additional controls and then again with different sets of controls. These controls include indicators for whether the sick spouse was diagnosed with an additional cancer during the five years after the initial diagnosis, whether the individual became a widow (widower), and whether the individual received Canada Pension Plan disability benefits or disability tax credits in a given year. They also include individuals' non-labour income, the number of children, and self-employment status.[20] Standard errors in all regressions are clustered on the individual level, which is equivalent to clustering on the family level because one observation is included for each couple and year.

Table 5 contains the results for men's employment.[21] Column 1, which shows the results without controls, confirms the graphical results in Chart 1. Men whose wife was diagnosed with cancer reduce their employment in the subsequent years. In particular, they are 2.2 to 2.4 percentage points less likely to work in the first three years after the diagnosis compared with men whose wife has never been diagnosed with cancer. In the fourth year, this negative effect increases to 3 percentage points, but no statistically significant effect is present in the fifth year. Overall, these results suggest that men significantly adjust their labour supply at the extensive margin for about the first four years after their wife's cancer diagnosis. After four years, cancer patients have likely recovered or may have passed away, so the need for caregiving is reduced and these men return to work.

20. Non-labour income is equal to total family income minus the individual's own earnings. The number of children was categorized as "no children," "1 child," "2 or 3 children," and "4 or more children." Self-employment status is defined based on having self-employment income from unincorporated businesses in a given year (income from incorporated businesses is reported on the tax form as wages and salaries).
21. Tables 5 to 12 only contain the estimates for the DID coefficients. Full regression results are available from the authors on request.

Table 5
Regression results for the effect of spousal cancer on men's employment

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	-0.011	-0.011	-0.011	-0.008	-0.006	-0.006
Standard error	0.007	0.007	0.007	0.007	0.007	0.007
k = -4						
Coefficient	0.000	0.000	0.000	-0.001	0.001	0.001
Standard error	0.007	0.007	0.007	0.007	0.007	0.007
k = -3						
Coefficient	0.002	0.002	0.002	0.002	0.004	0.004
Standard error	0.006	0.006	0.006	0.006	0.006	0.006
k = -2						
Coefficient	0.000	0.000	0.000	0.000	0.002	0.002
Standard error	0.005	0.005	0.005	0.005	0.005	0.005
k = -1 (reference year)						
k = 0 (diagnosis year)						
Coefficient	0.001	0.002	0.001	0.001	0.002	0.002
Standard error	0.006	0.006	0.006	0.006	0.006	0.006
k = +1						
Coefficient	-0.024 **	-0.023 **	-0.021 **	-0.025 **	-0.024 **	-0.020 *
Standard error	0.008	0.008	0.008	0.008	0.008	0.008
k = +2						
Coefficient	-0.023 **	-0.022 *	-0.017 †	-0.024 **	-0.024 **	-0.015 †
Standard error	0.009	0.009	0.009	0.009	0.009	0.009
k = +3						
Coefficient	-0.022 *	-0.020 *	-0.014	-0.022 *	-0.022 *	-0.011
Standard error	0.009	0.009	0.009	0.009	0.009	0.009
k = +4						
Coefficient	-0.030 **	-0.028 *	-0.022 *	-0.031 **	-0.030 **	-0.018 †
Standard error	0.011	0.011	0.011	0.011	0.011	0.011
k = +5						
Coefficient	-0.017	-0.014	-0.008	-0.018	-0.018 †	-0.007
Standard error	0.011	0.011	0.011	0.011	0.011	0.011
Additional cancer diagnosis	...	y	...	...	...	y
Lagged widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	167,832	167,832	167,832	166,625	166,625	166,625

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. Authors' calculations.
Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Columns 2 to 6 in Table 5 contain results for men's employment with added control variables. Overall, the estimates are stable, but less precise. Column 2 adds an indicator for an additional cancer diagnosis during the five-year follow-up period. While an additional diagnosis has a large negative effect on husbands' employment, this effect is not statistically significant (not shown). However, the DID estimates for the initial diagnosis are unchanged. Column 3 controls for lagged widowhood (i.e., an indicator that equals 1 if the individual's spouse passed away one year before or earlier is included).[22] Becoming a widower has a large negative but statistically insignificant effect on employment (not shown). The effects of the cancer diagnosis on employment become smaller in absolute value, but the overall pattern is similar to that estimated in Column 1. In

22. Because of the annual frequency of Statistics Canada's data, the lagged widowhood dummy is used to capture a full year of earnings and family income changes after becoming a widow (widower). Widowhood includes all causes of death among spouses. That is, men in the control group (whose wives were not diagnosed with cancer) may become widowed too.

Columns 4 and 5 of Table 5, controls are in place for non-labour income, number of children, and individuals receiving disability benefits, but no significantly different estimation results are found. Finally, when all of the above variables in Column 6 are controlled for, smaller decreases in employment after the cancer diagnosis are found, which are also estimated less precisely. The overall pattern is preserved, however.

All regressions in Table 5 contain interactions between the treatment variable (the individual's wife was diagnosed with cancer in $t = 0$) and time periods before the diagnosis. The effects of these pre-treatment interactions on the outcome variable allow placebo tests to be conducted (i.e., the common trends assumptions can be formally assessed). None of these interactions had a significant effect, therefore it can be concluded that wives' cancer diagnoses do not affect husbands' employment before they occur. This finding confirms the study's assumption that an initial cancer diagnosis changes a family's information set and spousal employment does not change in anticipation of such a health shock.

Next, the estimation results for men's earnings (reported in Table 6) are explored. The six regressions contain the same sets of control variables as the employment regressions described above. Starting in the year following the wife's cancer diagnosis, husbands earn about $2,000 less per year. With mean pre-diagnosis annual earnings of $59,000 in the matched treatment group, this corresponds to a 3.4% reduction in earnings. This negative effect remains stable for the following three years and disappears in the fifth year after the cancer diagnosis. Hence, the pattern is the same as for the employment effects. Given the graphical results described above, these results are not surprising. Most of the decline in labour supply occurs at the extensive margin, so employment and annual earnings exhibit similar patterns. The regressions results including control variables, which are reported in Columns 2 to 6 in Table 4, confirm the basic result on men's earnings. While the estimates become less precise as controls are added, the point estimates show a decrease in earnings of about $2,000 per year across specifications. The placebo tests also show that earnings do not change significantly in anticipation of a cancer diagnosis.

Table 6
Regression results for the effect of spousal cancer on men's annual earnings

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	178.136	174.990	172.416	364.814	254.955	243.834
Standard error	926.765	926.766	926.850	966.038	951.490	951.473
k = -4						
Coefficient	647.903	646.134	645.584	621.085	630.142	625.362
Standard error	800.363	800.386	800.369	804.458	794.450	794.509
k = -3						
Coefficient	849.855	849.277	848.997	795.221	733.322	731.397
Standard error	825.931	825.937	825.943	840.021	826.557	826.619
k = -2						
Coefficient	4.859	4.859	4.859	141.140	-33.893	-33.295
Standard error	596.819	596.820	596.822	602.412	601.292	601.337
k = -1 (reference year)						
k = 0 (diagnosis year)						
Coefficient	-435.020	-374.356	-435.020	-612.337	-550.489	-486.059
Standard error	590.864	592.313	590.868	595.190	597.396	598.693
k = +1						
Coefficient	-2,111.390 *	-1,990.062 *	-1,842.396 *	-2,594.977 **	-2,622.379 **	-2,170.408 *
Standard error	873.198	877.342	877.936	880.154	874.497	881.731
k = +2						
Coefficient	-1,993.458 *	-1,825.611 †	-1,380.116	-2,313.540 *	-2,384.956 *	-1,466.459
Standard error	1,005.925	1,011.304	1,022.897	991.473	991.437	1,007.228
k = +3						
Coefficient	-1,831.738 †	-1,591.309	-1,042.842	-2,094.360 †	-2,207.291 *	-998.357
Standard error	1,095.917	1,103.611	1,111.864	1,074.480	1,074.257	1,089.338
k = +4						
Coefficient	-2,546.762 *	-2,274.372 †	-1,707.019	-2,832.873 *	-2,946.032 *	-1,641.819
Standard error	1,228.601	1,234.837	1,252.031	1,200.361	1,206.337	1,227.779
k = +5						
Coefficient	-672.939	-392.370	184.293	-1,049.854	-1,117.810	216.080
Standard error	1,334.154	1,340.789	1,369.751	1,296.023	1,307.527	1,338.573
Additional cancer diagnosis	...	y	...	...	...	y
Lagged widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	167,832	167,832	167,832	166,625	166,625	166,625

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Table 7
Regression results for the effect of spousal cancer on men's total family income

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4
k = -5				
Coefficient	-193.457	-195.411	-194.331	-110.765
Standard error	1,266.303	1,266.423	1,266.208	1,265.661
k = -4				
Coefficient	290.143	289.950	290.391	376.218
Standard error	1,146.562	1,146.644	1,146.512	1,145.729
k = -3				
Coefficient	263.614	263.045	263.828	313.989
Standard error	1,144.189	1,144.221	1,144.179	1,142.642
k = -2				
Coefficient	879.818	878.922	880.401	909.003
Standard error	950.035	950.065	950.019	949.623
k = -1 (reference year)				
k = 0 (diagnosis year)				
Coefficient	-1,182.440	-1,371.809	-1,251.314	-923.442
Standard error	958.691	956.684	958.344	960.026
k = +1				
Coefficient	-4,408.536 ***	-4,903.173 ***	-4,328.716 ***	-3,735.748 **
Standard error	1,273.461	1,267.230	1,273.870	1,281.596
k = +2				
Coefficient	-2,380.738 †	-3,000.669 *	-2,000.923	-1,790.669
Standard error	1,318.710	1,328.243	1,323.633	1,321.976
k = +3				
Coefficient	-1,645.935	-2,267.298	-1,119.145	-1,065.668
Standard error	1,522.979	1,532.048	1,532.202	1,522.170
k = +4				
Coefficient	-2,463.894	-3,072.066 †	-1,904.179	-1,918.319
Standard error	1,602.354	1,627.109	1,627.503	1,603.411
k = +5				
Coefficient	-856.109	-1,409.221	-331.512	-471.001
Standard error	1,735.811	1,763.498	1,760.460	1,734.978
Widowhood	...	y	...	...
Lagged widowhood	...	...	y	...
Family size	y	y	y	y
Disability benefits or tax credits	...	...	...	y
Number of observations	166,625	166,625	166,625	166,625

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

*** significantly different from reference category ($p<0.001$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. Authors' calculations.
Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

The third outcome considered is total family income before taxes. Table 7 contains the results for men. In this case, the changes in the outcome variable due to a spousal cancer diagnosis potentially operate through two channels. First, the sick wife may reduce her employment or hours worked and therefore have lower earnings. Second, the husband may reduce his labour supply to act as a caregiver, which contributes to an overall decrease in family income. The results in Table 7 are consistent with the previous results in that they show the largest effect for the year immediately following the spousal cancer diagnosis. Depending on the specification, family income declined by about $4,000 to $5,000 (or 3.8% to 4.8%) for men whose wife was diagnosed

with cancer.[23] This decline is highly statistically significant. In subsequent years, the reduction in family income becomes smaller and is not statistically significant. Hence, after a wife's cancer diagnosis, the family is able to re-adjust total income in a relatively short time.

Next, regression results for women are reported. The treatment group consists of women whose husband was diagnosed with cancer between 1992 and 2003, and the control group contains women whose husband was never diagnosed with cancer. Table 8 displays the estimation results for women's employment using the same specifications in Columns 1 to 6 as for men. Overall, women reduced their employment by about 2.5 percentage points during the five years after their husband was diagnosed with cancer. In contrast to the results for men, women do not increase their employment rates in the fifth year after the diagnosis. They either care for their husband longer or do not return to the workforce for other reasons.[24] However, these effects are estimated less precisely than for men and are only statistically significant at the 5% level in the first year and at the 10% level in the second and third years. The point estimates do not change substantially when the control variables are included. As for men, the cancer diagnosis has no effect on women's employment in the pre-treatment periods; hence the common trends assumption is satisfied.

23. For family income, controlling for widowhood is attempted in two different ways: by including a lagged widowhood dummy as in Tables 5 and 6 and by including a widow (widower) dummy. Because of the annual frequency of family income data, the effect of spousal death on family income cannot be clearly determined with either of these two variables.
24. The women's sample contains proportionally more spouses diagnosed with cancer types in the low-survival category than the men's sample (Table 2). Cancer types in the low-survival category (e.g., lung cancer) may be more severe and take longer time for recovery from cancer treatment than those in the high-survival category (e.g., breast cancer).

Table 8
Regression results for the effect of spousal cancer on women's employment

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	-0.011	-0.011	-0.011	-0.015	-0.014	-0.014
Standard error	0.013	0.013	0.013	0.013	0.013	0.013
k = -4						
Coefficient	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
Standard error	0.012	0.012	0.012	0.012	0.012	0.012
k = -3						
Coefficient	0.009	0.009	0.009	0.009	0.007	0.007
Standard error	0.010	0.010	0.010	0.010	0.010	0.010
k = -2						
Coefficient	0.000	0.000	0.000	0.000	-0.002	-0.002
Standard error	0.007	0.007	0.007	0.007	0.007	0.007
k = -1 (reference)						
k = 0 (diagnosis year)						
Coefficient	-0.008	-0.008	-0.008	-0.008	-0.007	-0.007
Standard error	0.009	0.009	0.009	0.009	0.008	0.009
k = +1						
Coefficient	-0.026 *	-0.025 *	-0.024 *	-0.025 *	-0.024 *	-0.024 *
Standard error	0.012	0.012	0.012	0.012	0.011	0.012
k = +2						
Coefficient	-0.023 †	-0.022 †	-0.019	-0.022 †	-0.024 †	-0.023 †
Standard error	0.013	0.013	0.014	0.013	0.013	0.014
k = +3						
Coefficient	-0.028 †	-0.027 †	-0.023	-0.027 †	-0.028 †	-0.027 †
Standard error	0.015	0.015	0.016	0.015	0.014	0.016
k = +4						
Coefficient	-0.025	-0.024	-0.020	-0.024	-0.025	-0.024
Standard error	0.016	0.016	0.017	0.016	0.015	0.017
k = +5						
Coefficient	-0.023	-0.022	-0.017	-0.022	-0.021	-0.020
Standard error	0.017	0.017	0.018	0.017	0.016	0.018
Additional cancer diagnosis	...	y	...	...	...	y
Lagged widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	152,087	152,087	152,087	151,094	151,094	151,094

... not applicable

* significantly different from reference category ($p<0.05$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Table 9 contains results for women's annual earnings. The reduction in earnings amounts to $800 to $1,700 in the five years after the husband's cancer diagnosis in the baseline regression (Column 1). The earnings loss is highest in the first two years and then becomes less significant in both economic and statistical terms. Given average annual earnings of about $29,000, the initial earnings loss is substantial, however, at about 5.9%. As with the previous results, the effects of a cancer diagnosis become smaller in absolute value when control variables are added. The overall pattern persists, however, with negative point estimates in the first three years for all specifications. Lastly, it is possible to verify the common trends assumption for this set of results.

Table 9
Regression results for the effect of spousal cancer on women's annual earnings

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	-1.770	-1.234	-2.913	176.024	198.545	199.468
Standard error	592.460	592.431	592.448	611.951	612.374	612.233
k = -4						
Coefficient	502.356	502.675	502.691	551.513	593.883	594.318
Standard error	535.227	535.228	535.216	539.514	535.973	535.954
k = -3						
Coefficient	231.106	230.943	231.745	265.694	291.073	291.273
Standard error	500.865	500.864	500.883	502.288	504.384	504.380
k = -2						
Coefficient	356.480	356.480	356.480	362.589	347.064	347.133
Standard error	389.058	389.059	389.061	385.399	389.793	389.813
k = -1 (reference)						
k = 0 (diagnosis year)						
Coefficient	-713.501 *	-688.676 †	-713.501 *	-599.743 †	-599.333 †	-577.214
Standard error	356.472	357.872	356.475	358.252	357.233	358.639
k = +1						
Coefficient	-1,688.542 ***	-1,654.408 **	-1,378.871 **	-1,477.700 **	-1,518.224 **	-1,301.039 *
Standard error	507.256	510.902	521.294	504.525	506.972	524.954
k = +2						
Coefficient	-1,695.581 **	-1,656.692 **	-1,009.275	-1,450.197 *	-1,578.169 **	-1,125.393 *
Standard error	591.058	595.304	638.239	589.520	587.643	650.246
k = +3						
Coefficient	-1,388.761 *	-1,342.511 *	-573.889	-1,050.600	-1,223.678 †	-687.724
Standard error	663.708	670.028	726.194	662.627	657.010	736.856
k = +4						
Coefficient	-834.180	-781.897	62.710	-509.541	-562.101	27.235
Standard error	751.610	759.299	809.521	757.144	745.716	826.567
k = +5						
Coefficient	-1,406.644 †	-1,351.243	-440.334	-1,107.306	-1,037.640	-406.044
Standard error	845.863	855.317	918.192	848.025	839.187	930.974
Additional cancer diagnosis	...	y	...	...	...	y
Lagged widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	152,087	152,087	152,087	151,094	151,094	151,094

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

*** significantly different from reference category ($p<0.001$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Table 10
Regression results for the effect of spousal cancer on women's total family income

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4
k = -5				
Coefficient	-241.034	-230.490	-220.087	-234.268
Standard error	2,024.955	2,023.452	2,024.240	2,027.092
k = -4				
Coefficient	75.914	79.232	85.310	72.716
Standard error	1,815.672	1,815.372	1,815.525	1,816.903
k = -3				
Coefficient	-622.249	-617.602	-610.365	-617.536
Standard error	1,748.643	1,748.289	1,748.448	1,750.227
k = -2				
Coefficient	-113.448	-109.937	-105.883	-165.901
Standard error	1,794.005	1,793.682	1,793.823	1,794.701
k = -1 (reference year)				
k = 0 (diagnosis year)				
Coefficient	-3,667.799 *	-3,210.274 *	-4,233.406 **	-2,746.943 †
Standard error	1,636.482	1,615.914	1,641.902	1,643.149
k = +1				
Coefficient	-6,566.490 **	-5,563.087 **	-5,768.479 **	-5,107.035 *
Standard error	-2,046.039	2,010.836	2,041.824	2,051.005
k = +2				
Coefficient	-5,713.904 *	-4,568.443 *	-2,403.819	-4,730.918 *
Standard error	2,292.55	2,324.80	2,308.93	2,303.13
k = +3				
Coefficient	-9,012.329 ***	-7,797.006 ***	-5,047.852 *	-8,129.335 ***
Standard error	2,081.860	2,097.637	2,097.974	2,076.863
k = +4				
Coefficient	-7,996.957 **	-6,800.037 **	-3,889.298	-7,128.829 **
Standard error	2,447.703	2,487.625	2,493.446	2,443.529
k = +5				
Coefficient	-6,745.085 **	-5,571.927 *	-2,309.191	-5,991.915 *
Standard error	2,488.816	2,505.662	2,528.706	2,479.404
Widowhood	...	y	...	...
Lagged widowhood	...	...	y	...
Family size	y	y	y	y
Disability benefits or tax credits	...	...	...	y
Number or observations	151,094	151,094	151,094	151,094

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

*** significantly different from reference category ($p<0.001$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Finally, regression results for family income for women whose spouse was diagnosed with cancer are reported in Table 10. A husband's cancer diagnosis has a direct and an indirect effect on family income. The estimates in Table 10 show that the initial drop in family income is substantial, with $5,000 to $6,500 depending on the specification. In contrast to the results for men in Table 7, family income further drops in subsequent years. The largest reductions amount to $8,000 to $9,000 three years after the husband's cancer diagnosis. These large effects are due both to a reduction in employment and earnings of the husband who was diagnosed with cancer and the wife who works less in response. These results show the large negative effects of husbands' cancer diagnoses on the entire family's economic situation.

Overall, this study's regression results strongly suggest that men (women) reduce their employment and experience earnings losses after their wife (husband) is diagnosed with cancer. Hence, the caregiver effect dominates the added-worker effect in the context of cancer diagnoses

in Canada. The reduction in employment rates is similar across genders at about 2.4 percentage points, although men have higher average pre-treatment employment rates than women. In addition, men lose about 3.4% of their annual earnings while women lose about 5.9%. These findings suggest that women reduce their employment and earnings more than men in response to their spouse's cancer diagnosis.

4.2.3 Robustness and heterogeneity

Table 11 contains regression results for the same outcomes as Tables 5 to 10, but restrict the sample to individuals whose spouse survives for at least five years after his or her cancer diagnosis; hence, they exclude all individuals in the treatment and control groups who become widowed during the sample period.[25] Excluding window(er)s from the sample allows this study to consider effects of spousal cancer that are not confounded by the spouse's death (but the surviving spouses also have less severe cancer diagnoses). Comparing these results to the main results discussed above, the decrease in women's employment and earnings is found to be less pronounced in the no-widow sample. Also, the decline in the women's family income in the no-widow sample is smaller than in Table 10, and it is not statistically significant. The women's sample contains proportionally more spouses diagnosed with cancer types in the low-survival category than the men's sample, therefore excluding widows from the women's sample results in a smaller negative effect of cancer on all outcomes. In other words, it appears that women whose spouse is diagnosed with cancer reduce work and earnings mostly in cases where the diagnosis is particularly severe and their husband does not survive for at least five years after being diagnosed with cancer. In these cases, women's family income loss is likely to be persistent and substantial.

The results so far do not distinguish between different cancer sites. It is likely, however, that spouses react differently according to how severe a cancer diagnosis is. Four specific types of cancer that are the most common in each severity level are considered: lung cancer (low survival probability), colon cancer (medium survival probability), and breast and prostate cancer (high survival probability).[26]

25. The CEM weights have been re-calculated for samples excluding widows (widowers). Here only regression results for the baseline specification that corresponds to Column 1 in Tables 5 to 10 are displayed. The results with added controls are similar and are available from the authors on request.
26. Before estimating DID regressions for the effects of these cancer diagnoses on spouses' labour market outcomes, the CEM weights are recalculated because the treatment groups now consist of different individuals.

Table 11
Regression results for the effect of spousal cancer on labour market outcomes (no-widow [no-widower] sample)

	Men (female spouse)			Women (male spouse)		
δ (effects of spousal cancer), Equation (1)	Employment Column 1	Earnings Column 2	Total family income Column 3	Employment Column 4	Earnings Column 5	Total family income Column 6
k = -5						
Coefficient	-0.012	27.251	-8.941	-0.004	-77.103	-1,040.817
Standard error	0.008	1,030.788	1,399.350	0.017	743.686	2,737.737
k = -4						
Coefficient	-0.003	505.023	437.622	-0.005	117.861	230.373
Standard error	0.007	887.616	1,272.034	0.015	676.527	2,389.763
k = -3						
Coefficient	-0.004	533.862	620.184	0.011	122.954	-1,477.958
Standard error	0.007	935.293	1,271.698	0.013	670.030	2,268.303
k = -2						
Coefficient	0.000	6.411	1,514.898	0.000	627.967	1,208.016
Standard error	0.005	680.333	1,024.896	0.010	525.482	2,595.155
k = -1 (reference)						
k = 0 (diagnosis year)						
Coefficient	0.004	180.087	-622.458	-0.006	-440.876	-4,881.442 *
Standard error	0.007	679.910	1,016.761	0.011	481.243	2,226.157
k = +1						
Coefficient	-0.024 **	-2,002.301 *	-5,285.241 ***	-0.019	-807.244	-8,791.473 ***
Standard error	0.009	997.630	1,336.429	0.015	671.267	2,453.317
k = +2						
Coefficient	-0.018 †	-1,591.957	-2,380.740 †	-0.003	-811.900	-710.596
Standard error	0.010	1,115.499	1,378.831	0.016	755.776	2,876.388
k = +3						
Coefficient	-0.010	-1,627.775	-886.479	-0.031 †	-352.582	-3,855.757 †
Standard error	0.010	1,190.142	1,606.289	0.018	862.488	2,290.112
k = +4						
Coefficient	-0.024 *	-2,284.623 †	-2,291.568	-0.037 †	129.696	-4,783.320
Standard error	0.012	1,345.708	1,728.185	0.020	936.400	3,058.972
k = +5						
Coefficient	-0.008	-61.128	-601.510	-0.023	-427.332	-953.379
Standard error	0.012	1,467.209	1,863.448	0.020	1,051.468	3,042.091
Number of observations	134,433	134,433	133,424	98,457	98,457	97,895

* significantly different from reference category (p<0.05)
** significantly different from reference category (p<0.01)
*** significantly different from reference category (p<0.001)
† significantly different from reference category (p<0.10)

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. The post-diagnosis period includes k = {1,...,5} and observations for period k = 0 are excluded (see text for details). In Columns 3 and 6, family size is controlled. Authors' calculations.
Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Panel A of Table 12 contains the results for lung cancer. A comparison of the DID parameters with those in Tables 3 and 4 show that the decline in men's employment in response to their wives' lung cancer diagnosis is larger than the overall average response to all cancer types (9.6 percentage points instead of 1.6 percentage points). Women's employment is not significantly affected by their husbands' lung cancer diagnosis. Qualitatively similar results hold for annual earnings of men and women. For family income, a large and significantly negative effect is found only for women. Families in which the husband is diagnosed with lung cancer lose about $11,000 per year of before-tax family income.

In response to a spouse's colon cancer diagnosis, there are overall negative effects on employment, earnings and family income, but most of these effects are not statistically significant due to the smaller sample size (Panel B of Table 12). Finally, negative point estimates are also found for the effect of spouses' breast and prostate cancer diagnoses on individuals' labour

market outcomes in Panels C.1 and C.2 of Table 12. Some of these estimates are not significant or are only marginally significant, but they provide suggestive evidence for the negative impact of these more common but less severe cancer diagnoses on spousal labour market outcomes. Taken together, the point estimates in Table 12, in particular for men, show a clear positive relationship between the severity of the cancer diagnosis or survival probabilities of wives and their husband's decrease in employment and earnings, but not for family income.

Table 12-1

Difference-in-differences results for the effect of spousal cancer on men's and women's employment, annual earnings, and total family income, by cancer site — Lung and colon

	Men (female spouse)			Women (male spouse)		
	Employment	Earnings	Total family income	Employment	Earnings	Total family income
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Panel A – Lung cancer						
Post-diagnosis						
Coefficient	-0.066 ***	-6,810.125 ***	2,607.611 †	-0.040 *	-410.063	7,952.358 ***
Standard error	0.014	1,268.399	1,567.233	0.018	724.623	1,524.143
Spousal cancer × post-diagnosis						
Coefficient	-0.096 **	-10,688.340 **	-2,894.832	0.022	369.743	-11,180.290 **
Standard error	0.036	3,584.675	5,369.808	0.033	1,578.893	3,902.021
Constant						
Coefficient	0.933 ***	48,506.074 ***	69,976.363 ***	0.794 ***	23,227.702 ***	72,774.193 ***
Standard error	0.007	590.904	1,594.472	0.008	336.715	2,060.571
Family size controls	...	...	y	...	...	y
Number of observations	11,247	11,247	11,179	15,439	15,439	15,286
Panel B – Colon cancer						
Post-diagnosis						
Coefficient	-0.051 ***	-4,105.026 **	6,649.785 **	-0.052 *	-1,671.016 *	10,077.532 ***
Standard error	0.011	1,299.651	2,199.279	0.022	710.572	2,401.397
Spousal cancer × post-diagnosis						
Coefficient	-0.050	-7,295.031 †	-5,293.022	-0.063	-7,366.604 **	-7,198.142
Standard error	0.040	3,770.881	6,124.982	0.050	2,756.270	4,510.178
Constant						
Coefficient	0.962 ***	59,697.132 ***	86,019.060 ***	0.799 ***	28,062.624 ***	83,188.273 ***
Standard error	0.005	619.581	3,377.965	0.010	337.218	2,451.450
Family size controls	...	...	y	...	...	y
Number of observations	6,242	6,242	6,236	11,707	11,707	11,557

... not applicable

* significantly different from reference category (p<0.05)

** significantly different from reference category (p<0.01)

*** significantly different from reference category (p<0.001)

† significantly different from reference category (p<0.10)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. The post-diagnosis period includes $k = \{1,\ldots,5\}$ and observations for period $k = 0$ are excluded (see text for details). Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Table 12-2
Difference-in-differences results for the effect of spousal cancer on men's and women's employment, annual earnings, and total family income, by cancer site — Breast and prostrate

	Men (female spouse)			Women (male spouse)		
	Employment	Earnings	Total family income	Employment	Earnings	Total family income
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Panel C.1 – Breast cancer						
Post-diagnosis						
Coefficient	-0.055 ***	-5,471.360 ***	7,877.870 ***	...	...	...
Standard error	0.005	667.039	882.099	...	...	...
Spousal cancer × post-diagnosis						
Coefficient	-0.022 †	-2,867.047 †	-3,815.594 *	...	...	...
Standard error	0.011	-1,636.842	1,932.996	...	...	...
Constant						
Coefficient	0.970 ***	61,001.535 ***	87,325.143 ***	...	...	...
Standard error	0.002	309.426	1,297.952	...	...	...
Family size controls	...	...	y	...	...	...
Number of observations	62,520	62,520	62,203	...	...	...
Panel C.2 – Prostate cancer						
Post-diagnosis						
Coefficient	...	...	...	-0.079 ***	-2,295.817 **	10,370.193 ***
Standard error	...	...	...	0.012	875.247	2,611.576
Spousal cancer × post-diagnosis						
Coefficient	...	...	...	-0.055 *	-1,601.509	-4,967.644
Standard error	...	...	...	0.027	1,768.967	4,380.787
Constant						
Coefficient	...	...	...	0.824 ***	30,473.017 ***	95,154.504 ***
Standard error	...	...	...	0.005	407.159	2,462.641
Family size controls	...	...	...	...	...	y
Number of observations	...	...	...	24,310	24,310	24,220

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

*** significantly different from reference category ($p<0.001$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by Coarsened Exact Matching weights and include individual fixed effects. The post-diagnosis period includes $k = \{1,...,5\}$ and observations for period $k = 0$ are excluded (see text for details). Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

5 Discussion and conclusion

In this paper, unique and nationally representative administrative data are employed to estimate the effect of one spouse's cancer diagnosis on the other spouse's subsequent labour market outcomes. The results show that individuals reduce their employment, and their earnings decline, due to their spouse's health shock. In addition, the overall effect of one spouse's cancer diagnosis on his or her family's financial situation can be quantified by looking at the changes in before-tax family income. This study finds negative effects that are both statistically and economically significant. For example, both men and women whose spouses are diagnosed with cancer reduce their employment by about 2.4 percentage points, and a husband's cancer diagnosis leads to a total family income loss of up to 8.5% annually. The average annual income loss of $2,700 for men and $6,900 for women is substantial when compared to other types of costs incurred after a cancer diagnosis. For example, average out-of-pocket costs associated with cancer treatment amount to about $2,900 per year in Ontario (Longo et al. 2006), and the average cost to the health care system is about $26,000 per cancer diagnosis in the year following such a diagnosis (de Oliveira et al. 2013).[27]

The labour market effects of spousal health shocks are theoretically ambiguous, but this study's empirical results clearly reject the added-worker hypothesis in favour of the caregiver hypothesis. Individuals whose spouses are diagnosed with cancer (i.e., a sudden and severe negative change in health) decrease their employment and experience earnings losses. This result is mostly in line with the existing literature. For example, Hollenbeak, Short and Moran (2011) find negative employment effects for wives of cancer survivors, but not for husbands. On the other hand, Coile (2004) finds small positive labour supply effects for men, but not for women. In contrast to this study, the above-mentioned studies use data from the United States, where access to employer-sponsored health insurance may lead to stronger added-worker effects. For a country with a universal health insurance system similar to the Canadian one—the Netherlands—García-Gómez et al. (2013) find negative effects from spousal hospitalizations on employment and earnings for men. Their estimated effects are smaller than those in this study, which may be explained by the fact that they consider all types of hospitalizations whereas this paper considers only more severe health shocks associated with cancer diagnoses.

In contrast to other existing studies, this analysis finds a smaller difference in labour market effects between male and female spouses. Specifically, only slightly larger (in relative terms) negative effects for women's employment and earnings are found relative to those for men. However, Coile (2004) finds that wives' employment increases less than husbands' employment. Hollenbeak, Short and Moran (2011) find that wives' employment decreases more than husbands' employment, while García-Gómez et al.'s (2013) results show the opposite. Several reasons can explain these discrepancies. First, men and women in the United States, the Netherlands and Canada may have different labour supply profiles. For example, if men's employment rates are higher than women's, men may reduce their labour supply in response to their wives' health shocks while women are more likely to replace their husbands' lost income. García-Gómez et al. (2013) observe this pattern in the Netherlands, while this study finds slightly stronger negative effects for women although men's employment rates are also higher in Canada.

Second, different caregiving options may play a role in employment effects. More easily available or more affordable institutionalized care can replace informal caregiving by spouses, which would lead to smaller or non-existing caregiver effects. Differences between the Canadian and Dutch health care systems may explain why negative employment effects are found for women, in contrast to García-Gómez et al. (2013).

27. The authors are grateful to Sara Allin for pointing out these studies.

Finally, differences in the types of health shocks considered in these studies can also explain different findings. More particularly, individuals may reduce their labour supply to care for a disabled spouse after his or her hospitalization, but a cancer diagnosis often implies that the affected spouse's life expectancy is suddenly reduced. In this case, the other spouse may want to work less temporarily in order to spend time with the sick husband or wife.[28] Therefore, the larger negative employment and earnings effects that are found for both husbands and wives in response to spousal cancer may be due to both caregiving needs and the desire to enjoy leisure time together after a cancer diagnosis. Moreover, the combination of caregiving needs and leisure complementarities also explains why men and women reduce employment and earnings to a similar extent—the latter are likely independent of the gender of the diagnosed spouse.

Overall, this study's results provide novel and important evidence on the intra-family labour market effects of one family member's severe health shock. The magnitudes of these effects are substantial, suggesting that a cancer diagnosis has the potential to change labour supply from a level that is optimal when both spouses are healthy and can strongly affect a family's financial well-being—in addition to the psychological costs of dealing with such a health shock.

28. Such complementarities in leisure time are a major concern in modeling couples' labour supply (see Michaud and Vermeulen [2011] for a recent study).

Appendix 1 Data description

The 1991 Census–Longitudinal Worker File (LWF) is a unique dataset that combines data from five sources: Canada's 1991 Census of Population, the Canadian Mortality Database (CMDB), the Canadian Cancer Database (CCDB), the LWF and the T1 Family File (T1FF).

The CMDB contains individual death records from 1950 onward. Provincial and territorial Vital Statistics offices provide these records annually to Statistics Canada for national-level analysis.

The CCDB is a databank combining two cancer-related data sources: the Canadian Cancer Registry (CCR) and the National Cancer Incidence Reporting System (NCIRS). The former is a person-oriented tumor database that includes clinical and demographic information about Canadian residents with cancer since 1992 (Statistics Canada 2008). The latter is a historical tumor-oriented database containing cancer cases diagnosed as far back as 1969 (Carpenter et al. 2008). Individual cancer records from the CCR are used in the analysis; historical information from the NCIRS is used to verify that individuals in the CCR had no prior cancer history.

The LWF represents 10% of the random sample of Canadians who either filed a personal income tax form (Form T1 General, *Income Tax and Benefits Return*) or received a statement of remuneration (Form T4, *Statement of Remuneration Paid (Slip)*) from their employer in each year from 1983 onward. Once individuals are selected into the LWF, they are followed regardless of their employment status for as long as they file a tax return (Form T1 General) or their income is reported to the Canada Revenue Agency by their employers. The current version of the LWF contains information on wages, salaries and net self-employment income as well as firm-level information.[29] Wages and salaries are obtained from T4s issued by employers. Net self-employment income and basic personal information (marital status, province of residence, etc.) are obtained from the personal income tax files (T1).[30]

The T1FF is a family tax file that is built annually based on the information included in the personal income tax files (T1) and supplementary files such as the Canada Child Tax Benefit. A tax unit in Canada is an individual. Using a combination of information available in the T1 along with family benefit information, Statistics Canada constructs the T1FF on an annual basis. The taxfiler's spouse is primarily identified based on the spouse's social insurance number (SIN) in the T1, while children are identified based on their parents' tax return and child benefits program files. Individuals can be followed over time using their SIN, and their family income can be constructed in each year using their family identifier from the T1FF.

Statistics Canada's Health Analysis Division initially linked selected personal information from CMDB and CCDB to the individual records of individuals 25 and over in the 1991 Census file. This initial data linkage is called '1991 Canadian Census Cohort: Mortality and Cancer Follow-Up.' Individuals' death records up to 2006 and individuals' cancer records up to 2003 were obtained from both the CMDB and the CCDB. Subsequently, the LWF records were linked to the 1991 Canadian Census Cohort to provide the crucial income component. The T1FF was added later to provide the spousal and total family income components.

The 1991 Census–LWF data sample contains 263,674 individual records corresponding to about 1.4% of the Canadian population aged 25 and over in 1991. Approximately 58.8% of the 1991 Census–LWF cohort was observed in all 28 years of the LWF (from 1983 to 2010). Individuals were present in the sample for an average of 24.8 years. Tax filing rates were slightly lower in the 1980s compared with more recent decades (from 1990 to 2010), and 66.9% of the 263,638 individuals were observed in all 21 years, for an average of 18.5 years.

29. Net self-employment income is income from unincorporated businesses; income from incorporated businesses is reported as wages and salaries.
30. Filing rates in Canada are very high primarily because of tax benefits such as refundable Goods and Service Tax (GST) credits, which provide incentives for filing tax returns—even for individuals with low income or no income.

Appendix 2 Inverse propensity score weighting

As an alternative to Coarsened Exact Matching weighting, regression results are also provided where the data are weighted using estimated inverse propensity score weights before the effect of spousal cancer on individuals' labour market outcomes is estimated. Propensity scores are obtained by estimating a probit regression of treatment status (the individual's spouse was diagnosed with cancer) using the following independent variables: individual's and spouse's age (both in five-year bins), individual's and spouse's education categories, a visible minority indicator, number of children, age of the youngest child, employment indicators for the individual and the spouse for five years prior to the diagnosis, individual's and spouse's earning quintiles for five years prior to the diagnosis, individual's non-earned income quintiles and family income quintiles for five years prior to the diagnosis, and year and province dummies. To assign a placebo-diagnosis year to individuals in the control group, a year between 1992 and 2003 is randomly drawn for each control observation. After estimating probits of treatment status separately for men and women, inverse propensity score weights are obtained as $w_i = \frac{C_i}{\hat{p}_i} + \frac{1-C_i}{1-\hat{p}_i}$, where C_i is an indicator for treatment status (spousal cancer diagnosis) and $\hat{p}_i$ is the predicted treatment probability for individual i based on the probit regression described above.

Appendix Table 1
Regression results for the effect of spousal cancer on men's employment (inverse propensity score weights)

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	0.000	0.000	-0.000	-0.001	0.002	0.002
Standard error	0.005	0.005	0.005	0.005	0.005	0.005
k = -4						
Coefficient	-0.001	-0.001	-0.001	-0.002	-0.000	-0.000
Standard error	0.005	0.005	0.005	0.005	0.005	0.005
k = -3						
Coefficient	-0.002	-0.002	-0.002	-0.003	-0.001	-0.001
Standard error	0.005	0.005	0.005	0.005	0.005	0.005
k = -2						
Coefficient	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001
Standard error	0.003	0.003	0.003	0.003	0.003	0.003
k = -1 (reference year)						
k = 0 (diagnosis year)						
Coefficient	0.002	0.003	0.002	0.003	0.003	0.003
Standard error	0.003	0.003	0.003	0.003	0.003	0.003
k = +1						
Coefficient	-0.015 *	-0.014 †	-0.011	-0.016 *	-0.014 †	-0.010
Standard error	0.007	0.007	0.007	0.007	0.007	0.008
k = +2						
Coefficient	-0.011	-0.010	-0.003	-0.011	-0.010	-0.001
Standard error	0.008	0.008	0.008	0.008	0.008	0.008
k = +3						
Coefficient	-0.021 *	-0.020 †	-0.011	-0.021 *	-0.020 *	-0.008
Standard error	0.010	0.010	0.010	0.010	0.010	0.010
k = +4						
Coefficient	-0.028 *	-0.026 *	-0.017	-0.028 *	-0.026 *	-0.013
Standard error	0.012	0.012	0.012	0.012	0.012	0.012
k = +5						
Coefficient	-0.016	-0.014	-0.005	-0.015	-0.016	-0.003
Standard error	0.012	0.012	0.012	0.012	0.012	0.012
Additional cancer diagnosis	...	y	...	...	...	y
Widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	151,904	151,904	151,770	151,904	151,904	151,770

... not applicable

* significantly different from reference category ($p<0.05$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by inverse propensity score weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Appendix Table 2
Regression results for the effect of spousal cancer on men's annual earnings (inverse propensity score weights)

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	511.613	511.613	445.862	298.883	635.178	589.471
Standard error	981.703	981.706	984.387	985.210	973.527	976.845
k = -4						
Coefficient	81.860	81.860	81.860	-75.450	183.444	177.863
Standard error	907.681	907.684	907.687	917.577	902.458	902.692
k = -3						
Coefficient	-57.477	-57.477	-57.477	-217.102	-29.031	-32.483
Standard error	911.381	911.384	911.387	920.792	922.186	922.917
k = -2						
Coefficient	-751.126	-751.126	-751.126	-774.462	-774.315	-774.904
Standard error	637.093	637.096	637.098	649.399	646.830	647.490
k = -1 (reference year)						
k = 0 (diagnosis year)						
Coefficient	-552.108	-533.797	-552.108	-584.618	-654.277	-636.327
Standard error	747.772	749.162	747.777	746.719	749.765	751.453
k = +1						
Coefficient	-1,606.375	-1,565.224	-1,250.962	-2,069.257 †	-2,124.170 *	-1,658.077
Standard error	1,095.007	1,099.043	1,096.835	1,060.944	1,080.232	1,084.163
k = +2						
Coefficient	-1,607.009	-1,547.061	-866.774	-1,936.240 †	-2,087.248 †	-1,117.478
Standard error	1,226.256	1,233.729	1,257.715	1,159.715	1,196.652	1,222.535
k = +3						
Coefficient	-1,931.482	-1,843.169	-911.188	-2,159.164	-2,349.838	-997.942
Standard error	1,537.423	1,551.717	1,569.487	1,465.158	1,521.037	1,542.436
k = +4						
Coefficient	-3,356.442 *	-3,242.338 *	-2,250.396	-3,723.151 *	-4,028.279 *	-2,546.677
Standard error	1,624.175	1,641.792	1,681.743	1,552.668	1,608.149	1,662.418
k = +5						
Coefficient	-2,679.927	-2,559.966	-1,612.419	-3,005.072 †	-3,393.407 *	-1,950.087
Standard error	1,710.397	1,729.747	1,770.432	1,623.973	1,696.868	1,757.676
Additional cancer diagnosis	...	y	...	...	...	y
Widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	151,904	151,904	151,770	151,904	151,904	151,770

... not applicable

* significantly different from reference category ($p<0.05$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by inverse propensity score weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Appendix Table 3
Regression results for the effect of spousal cancer on men's total family income (inverse propensity score weights)

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3
k = -5			
Coefficient	122.075	125.661	192.695
Standard error	1,312.737	1,312.867	1,311.126
k = -4			
Coefficient	-141.559	-134.841	-105.865
Standard error	1,286.995	1,286.879	1,288.150
k = -3			
Coefficient	-434.466	-431.456	-399.605
Standard error	1,230.722	1,230.449	1,230.024
k = -2			
Coefficient	-676.319	-673.867	-626.214
Standard error	930.951	930.628	930.737
k = -1 (reference year)			
k = 0 (diagnosis year)			
Coefficient	-625.730	-743.789	-388.429
Standard error	1,116.322	1,121.377	1,120.110
k = +1			
Coefficient	-3,845.556 **	-4,130.732 **	-3,124.817 *
Standard error	1,486.116	1,445.498	1,502.312
k = +2			
Coefficient	-2,516.630 †	-2,907.594 †	-1,812.603
Standard error	1,468.683	1,499.125	1,468.214
k = +3			
Coefficient	-2,246.215	-2,642.075	-1,482.411
Standard error	1,952.065	1,971.008	1,966.277
k = +4			
Coefficient	-5,187.331 **	-5,531.033 **	-4,543.705 *
Standard error	1,968.242	2,017.487	1,973.841
k = +5			
Coefficient	-4,024.501 †	-4,348.899 *	-3,484.230
Standard error	2,119.472	2,168.576	2,121.683
Widowhood	...	y	...
Lagged widowhood	...	...	y
Family size	y	y	y
Disability benefits or tax credits	...	...	...
Number of observations	151,904	151,904	151,904

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by inverse propensity score weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Appendix Table 4
Regression results for the effect of spousal cancer on women's employment (inverse propensity score weights)

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	0.004	0.004	0.006	0.005	0.003	0.005
Standard error	0.013	0.013	0.013	0.013	0.013	0.013
k = -4						
Coefficient	0.009	0.009	0.009	0.009	0.009	0.009
Standard error	0.011	0.011	0.011	0.011	0.011	0.011
k = -3						
Coefficient	0.000	0.000	0.000	0.000	-0.001	-0.001
Standard error	0.009	0.009	0.009	0.009	0.009	0.009
k = -2						
Coefficient	-0.008	-0.008	-0.008	-0.008	-0.012 *	-0.012 *
Standard error	0.007	0.007	0.007	0.007	0.006	0.006
k = -1 (reference)						
k = 0 (the year of diagnoses)						
Coefficient	0.005	0.005	0.005	0.005	0.007	0.007
Standard error	0.007	0.007	0.007	0.007	0.007	0.007
k = +1						
Coefficient	-0.014	-0.014	-0.009	-0.014	-0.012	-0.008
Standard error	0.013	0.013	0.011	0.013	0.011	0.011
k = +2						
Coefficient	-0.019	-0.019	-0.006	-0.018	-0.018	-0.009
Standard error	0.015	0.016	0.015	0.016	0.015	0.015
k = +3						
Coefficient	-0.041 *	-0.041 *	-0.026	-0.040 *	-0.040 *	-0.028 †
Standard error	0.018	0.018	0.018	0.018	0.017	0.017
k = +4						
Coefficient	-0.035 †	-0.035 †	-0.018	-0.033 †	-0.034 *	-0.021
Standard error	0.018	0.018	0.018	0.018	0.017	0.017
k = +5						
Coefficient	-0.034 †	-0.034 †	-0.017	-0.033 †	-0.034 †	-0.021
Standard error	0.019	0.019	0.019	0.019	0.018	0.018
Additional cancer diagnosis	...	y	...	...	...	y
Widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	139,167	139,167	139,041	139,167	139,167	139,041

... not applicable

* significantly different from reference category ($p<0.05$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by inverse propensity score weights and include individual fixed effects. Authors' calculations.
Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Appendix Table 5
Regression results for the effect of spousal cancer on women's annual earnings (inverse propensity score weights)

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
k = -5						
Coefficient	-215.306	-215.306	-356.785	-140.251	-167.588	-312.622
Standard error	828.461	828.464	825.796	804.225	834.555	829.947
k = -4						
Coefficient	-118.928	-118.928	-118.928	-55.526	-41.118	-40.831
Standard error	746.904	746.907	746.910	742.483	758.507	757.541
k = -3						
Coefficient	-698.809	-698.800	-698.809	-670.535	-689.206	-686.738
Standard error	763.180	763.182	763.185	763.036	765.987	766.047
k = -2						
Coefficient	111.631	111.631	111.631	109.448	71.474	74.969
Standard error	398.242	398.244	398.245	398.877	396.891	397.196
k = -1 (reference)						
k = 0 (the year of diagnosis)						
Coefficient	-688.200	-730.529	-688.200	-594.746	-643.625	-692.799
Standard error	432.641	447.530	432.644	429.544	430.982	445.230
k = +1						
Coefficient	-1,757.347 *	-1,814.422 *	-1,289.262 *	-1,575.440 *	-1,622.432 *	-1,316.881 *
Standard error	703.732	723.634	632.776	727.339	676.902	639.014
k = +2						
Coefficient	-1,984.508 *	-2,042.132 *	-996.046	-1,758.351 *	-1,856.320 *	-1,130.478
Standard error	784.385	799.530	762.733	806.779	778.815	766.221
k = +3						
Coefficient	-1,822.900 *	-1,889.776 *	-629.494	-1,480.009 †	-1,636.194 *	-763.996
Standard error	838.011	855.840	841.893	856.816	823.420	834.242
k = +4						
Coefficient	-1,201.565	-1,273.016	117.213	-865.606	-965.202	-0.151
Standard error	930.635	951.225	966.545	962.556	935.045	953.521
k = +5						
Coefficient	-1,844.008 †	-1,917.342 †	-447.842	-1,482.298	-1,526.249	-506.931
Standard error	1,059.359	1,080.030	1,101.544	1,086.915	1,071.184	1,076.368
Additional cancer diagnosis	...	y	...	...	...	y
Widowhood	...	...	y	...	...	y
Non-labour income	...	...	...	y	y	y
Number of children	...	...	...	...	y	y
Self-employment in reference period	...	...	...	...	y	y
Disability benefits or tax credits	...	...	...	...	y	y
Number of observations	139,167	139,167	139,041	139,167	139,167	139,041

... not applicable

* significantly different from reference category ($p<0.05$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by inverse propensity score weights and include individual fixed effects. Authors' calculations.

Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

Appendix Table 6
Regression results for the effect of spousal cancer on women's total family income (inverse propensity score weights)

δ (effects of spousal cancer), Equation (1)	Column 1	Column 2	Column 3
k = -5			
Coefficient	2,262.207	2,189.628	2,221.673
Standard error	2,443.587	2,443.580	2,445.412
k = -4			
Coefficient	1,725.706	1,660.453	1,680.873
Standard error	2,065.112	2,063.879	2,067.790
k = -3			
Coefficient	997.441	1,005.760	986.607
Standard error	2,027.917	2,025.829	2,029.019
k = -2			
Coefficient	1,321.435	1,361.852	1,279.009
Standard error	1,985.549	1,982.260	1,986.757
k = -1 (reference year)			
k = 0 (diagnosis year)			
Coefficient	-1,943.475	-317.542	-1,516.975
Standard error	1,936 932	1,943.195	1,970.708
k = +1			
Coefficient	-4,121.282	-937.699	-3,507.066
Standard error	3,041.515	3,076.748	3,099.059
k = +2			
Coefficient	-4,821.163	-1,005.661	-4,337.618
Standard error	3,042.538	2,971.138	3,106.370
k = +3			
Coefficient	-8,420.245 *	-4,033.353	-8,037.977 *
Standard error	3,348.437	3,166.194	3,392.634
k = +4			
Coefficient	-8,181.911 *	-3,997.711	-7,863.081 *
Standard error	3,428.556	3,345.732	3,462.118
k = +5			
Coefficient	-9,547.691 **	-5,379.574 †	-9,175.774 **
Standard error	3,363.704	3,176.313	3,383.884
Widowhood	...	y	...
Family size	y	y	y
Disability benefits or tax credits	...	...	y
Number of observations	139,167	139,167	139,167

... not applicable

* significantly different from reference category ($p<0.05$)

** significantly different from reference category ($p<0.01$)

† significantly different from reference category ($p<0.10$)

y controls included in the regression

Notes: All regressions are weighted by inverse propensity score weights and include individual fixed effects. Authors' calculations.
Source: Statistics Canada, 1991 Census–Longitudinal Worker File.

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